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Vibrating Machine Sets Brick in Monolithic Pavement. Note Brick Form Rails and How They Are Braced. Contractors' Grout Machine Immediately Behind Vibrator.

MECHANIZATION, the FEATURE of *VIBRATED MONOLITHIC BRICK PAVEMENT*

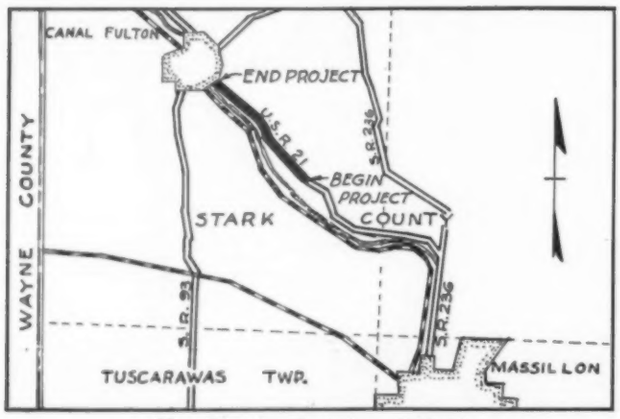
Ohio Job Has Special Expansion Joint Construction

By L. L. LUKE

Project Engineer, Ohio State Highway Department

ANOTHER step forward in modern road design and construction has been taken by the Ohio State Highway Department in the building of 2.194 miles of monolithic brick road, 20 ft. wide, mechanically vibrated on a 9-7-7-9 in. concrete base. The cost of the job will be approximately $158,200.

Monolithic construction is not a new idea. Sections of roads of this type were built in this area as early as 1916. Today, there are quite a few miles of monolithic construction throughout Ohio. Up to this time, a hand roller was mostly used to "set" the brick in the wet concrete. By this method, it was difficult to obtain a smooth even surface and because of this fact, it somewhat retarded the progress of this type of road construction. However, it is conceded that the stability of this type of pavement stands unquestioned.

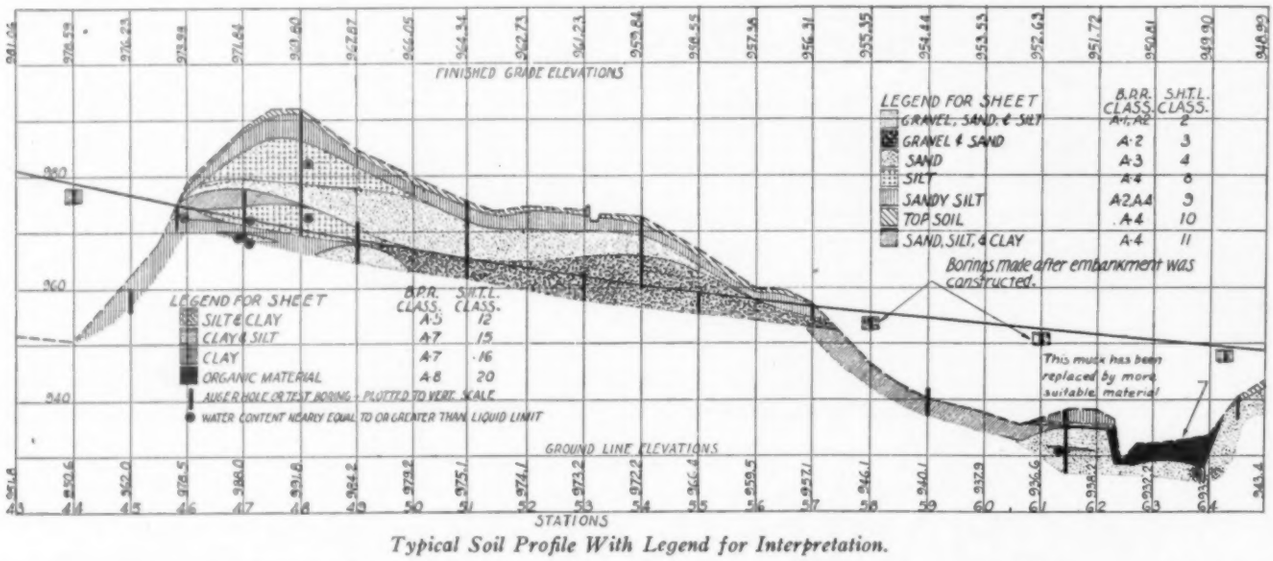


Map Showing Location of Road

It remained for the Metropolitan Brick Co., Canton, O., working with the Flexible Road Joint Machine Co., Warren, O., to develop a mechanical vibrating machine, designed to give the brick a smooth, even surface, thereby overcoming the principal objection held in the past concerning monolithic brick pavements. The state highway department has opened the way to prove its possibilities. This is a federal aid project, located in Stark County, Ohio, on the Cleveland,Massillon Road, U. S. Route 21, and is being constructed by the Elmer O. Vogt Paving Co., Massilon, O.

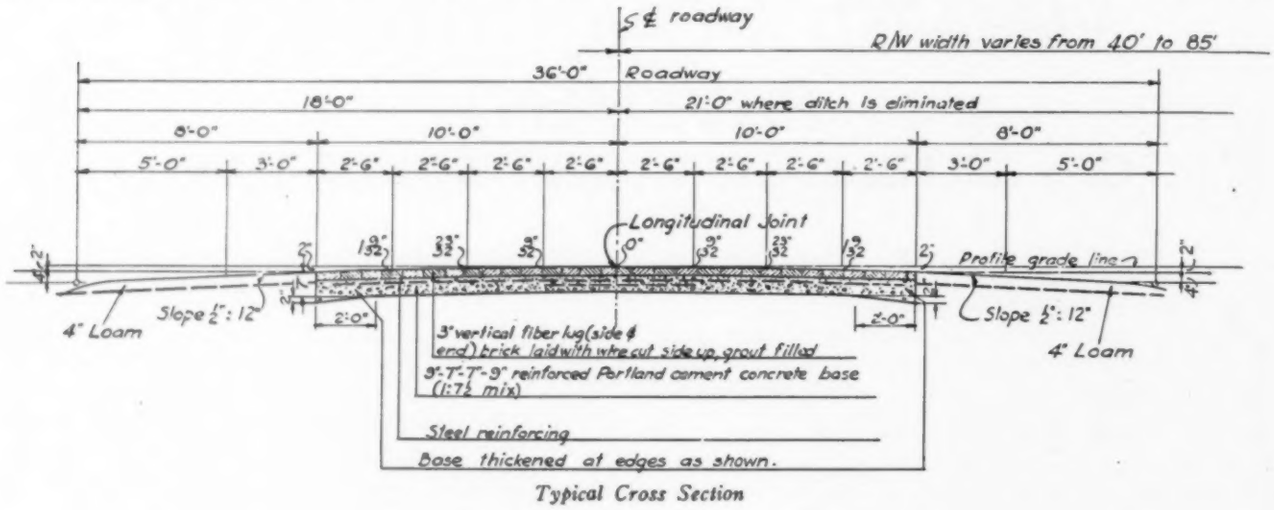
Earth Work.—In the construction of the road it was necessary to excavate over 100,000 cu. yds. of earth, 90 per cent of which was placed in fills. Shrinkage was figured at 30 per cent.

This work was done with two 12-cu. yd. and one 8-cu. yd. Le-Tourneau scrapers. The scrapers were pulled by two RD-8 and one RD-7 diesel Caterpillar tractors. This equipment was especially advantageous on this project because of its adaptability to mix the unusual variety of soils that were encounterel in both excavating and spreading. Because of these two facts, a high degree of soil stabilization was easily obtained in the fills. This equipment also aided in compaction because of its weight and constant travel back and forth over each layer of fill. This was borne out by the fact that a large percentage of compaction tests exhibited maximum compaction. There were several sizeable deposits of water bearing silts uncovered and wasted (shown in soil profile). As the equipment passed over these formations, water came to the surface like a sand boil and the surface would rise and fall much like rubber ice, while merely walking over it. This silt was both brown and blue and very fine. Tests showed that 95 per cent passed a 200-mesh sieve.


FINISHED GRADE ELEVATIONS
LEGEND FOR SHEET
B.P.R. CLASS.
S.H.T.C. CLASS.
GRAVEL, SAND, & SILT A-1, A2 2
GRAVEL & SAND A-2 3
SAND A-3 4
SILT A-4 6
SANDY SILT A2,A4 9
TOP SOIL A-4 10
SAND, SILT, & CLAY A-4 11
Borings made after embankment was constructed.
LEGEND FOR SHEET
B.P.R. CLASS.
S.H.T.C. CLASS.
SILT & CLAY A-5 12
CLAY & SILT A-7 15
CLAY A-7 16
ORGANIC MATERIAL A-8 20
AUGER HOLE OR TEST BORING - PLOTTED TO VERT. SCALE
WATER CONTENT NEARLY EQUAL TO OR GREATER THAN LIQUID LIMIT
This muck has been replaced by more suitable material
GROUND LINE ELEVATIONS
STATIONS

Typical Soil Profile With Legend for Interpretation.

Soil Profile.—A soil profile was made from borings



Typical Cross Section

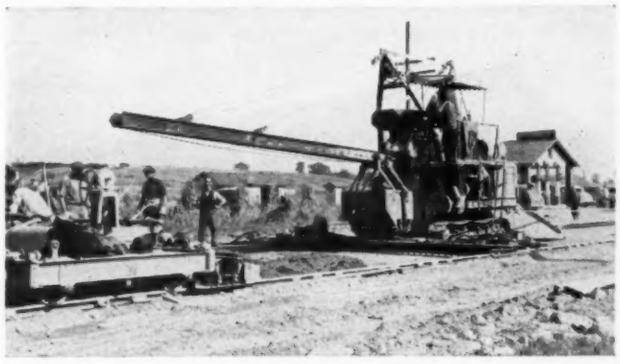
taken on the center line the full length of the job, prior to and during construction, under the direction of the state highway testing laboratory. The patchy occurrence and mixture of clay, gravel, silt, and many varieties of sand, evidenced one of the most unusual soil conditions in the state. This information will prove valuable as time goes on, in watching the behavior of the pavement.

Concrete Forms.—The concrete base forms were set on a grade cut by a form grader, saving considerable time and labor and procuring a solid even surface for the forms. The fine grade was cut by a Lakewood subgrader. A Heltzel subgrade planer hooked to the back of the mixer evened any irregularities in the sub-grade. This was checked by a heavy pin templet, pushed by hand back of the planer.

Concrete.—All concrete was designed by the absolute volume control method based on 4.6 sacks of cement and 31.28 gallons of water to the cubic yard. The dry weights of aggregates used were 102½ lbs. for sand, 90.8 lb. for No. 3 gravel, 98.8 lb. for No. 4 gravel, and 102½ lb. for a 45 per cent and 55 per cent mixture of No. 3 and No. 4 gravel. This mix design varied only slightly with the moisture content of the aggregates from day to day. The results were good as to yield, beam, and cylinder tests. A five sack batch was used with a total average weight of 4,460 lb., including an average of 24 gallons of loose water, making a total of 29.35 cu. ft.

There are 12 square feet in the cross section of the base. One lineal foot of base contains 0.444 cu. ft. of concrete and uses 2.04 sacks of cement. A lineal foot of road also contains 2,222 square yards of base and one batch of concrete covered 2.46 lineal feet of road.

The cement was furnished by the Diamond Portland Cement Co. of Middlebranch, Ohio, shipped to plant No. 8 of The American Aggregates Corp. at Crystal Springs, Ohio, four miles south of the job. Here the aggregates were batched in two-compartment trucks. The bagged cement was loaded on each batch from a platform by a siding and delivered with the aggregates (under contract) to the mixer on a tonnage basis. The cement sacks were opened from another platform, built on skids to the height of the trucks set in front of the mixer.



Paver, Subgrade Planer, Scratch Template, and Finishing Machine at Work on Concrete Base

When These Men Are at Work, They Prepare the Subgrade With Subgrade Planer Shown

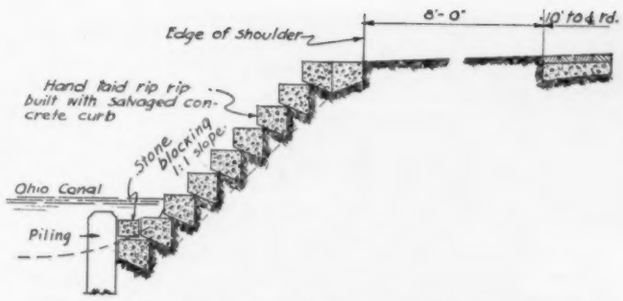


Diagram of Rip Rap Wall Made From Salvaged Concrete Curbing

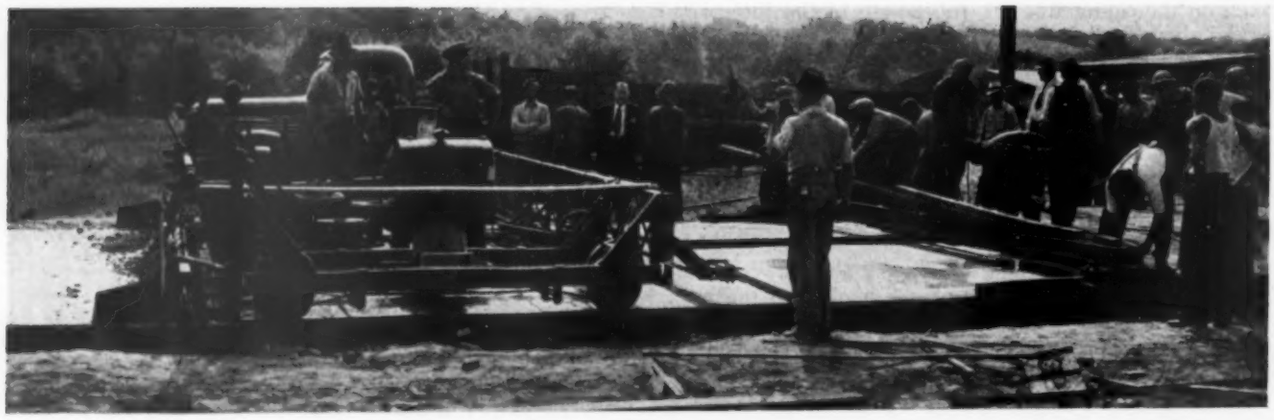
The concrete specifications called for a slump of a ½ in. to 1½ in. It was found that a ¾ in. slump for the first few hours in the morning, and the last hour of pouring and a 1 in. to 1¼ in. slump during the day proved best for the laying and vibrating of the brick. A 27-E Multi-Foote paver was used. Six thousand barrels of cement were used in the base, giving an overrun of 96 barrels or 1.6 per cent, due mostly to a low subgrade. Water was pumped about 2 miles with a Bronx triplex road pump.

Machinery.—The machinery on this job in full operation, truly presented a picture of a mechanical parade crawling along to the tempo of gasoline engines and the din of vibrating units. The first three machines to be described are products of the Flexible Road Joint Machine Co. of Warren, Ohio, and were operated on a rental basis.

The first machine following the mixer was a concrete vibrating and finishing machine, known as a Flex-Plane. All the movements of this machine are electrically driven, power being produced by a gasoline engine-generator set. The first pass of this machine screeded the concrete 2 in. below the top of the Heltzel base forms for the placing of bar mats, by dropping a hinge plate on the front of the screed. On the second and third pass the hinge plates were lifted and the concrete placed on the bar mats was vibrated, shaped to crown and given an initial finish by the screed which was set 1/16 in. higher than the required crown of 2 in. on the tangents which was flattened through super-elevations. This was done to allow a little extra concrete for the second finishing machine.

The First Finishing Machine Vibrates the Concrete and Strikes It Off So That Reinforcing Steel Can Be Placed. Note That This Strikeoff Plate Is Raised for Surface Finishing of the Base.

The vibration was produced by three electric motor vibrator units mounted on the screed. These units consisted of an eccentric, connected by a hard rubber sleeve to an electric motor operated at 3,600 revolutions per minute. The vibration produced a mortar on the surface



The Second Finishing Machine Brings Surface to True Shape and Inserts Longitudinal Joint Material. Shown in This Picture, Also, Are the Brick Conveyors Which Operate on the Added Brick Form Placed on Top of and Fastened to the Base Forms.

and the lateral motion of the screed gave a plastic finish to the concrete.

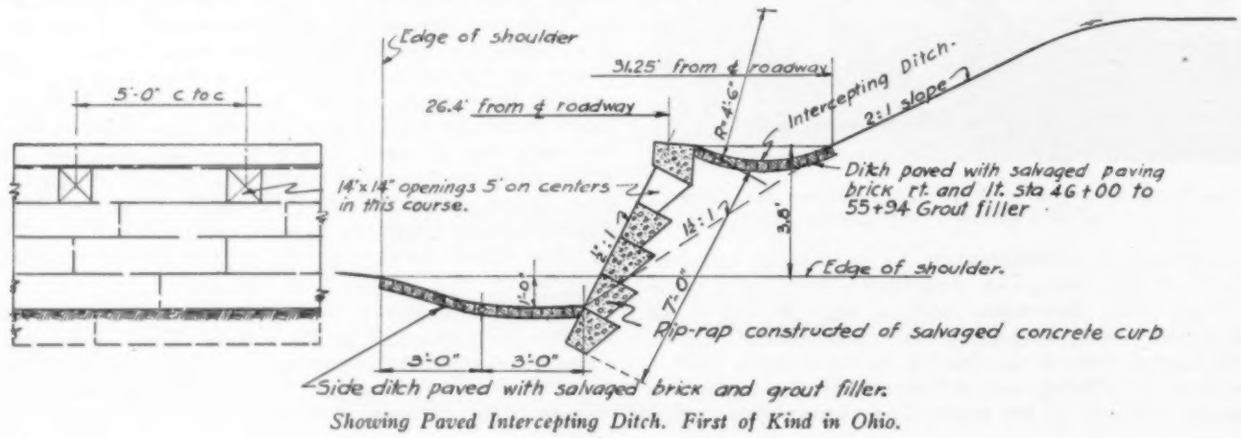
The second machine, also a Heltzel unit, a combination finishing and joint placing machine operated from gasoline engine power only. Its screed was set to the exact crown of the finished road. This second machine also made two passes over the concrete and operated its screed in the same manner as the first machine minus the vibrating. On the second pass, the machine paused every 30 inches to permit the placing of ⅛ in by 5½ in. center longitudinal composition ribbon joint which was set 2½ in. in the concrete and 3 in. allowed to protrude for a fracture plane between the brick. This ribbon was held in place with bent tin plates, 30 in. long. These plates were removed just before the bricks were batted in the center. The insert and cap (shown in the drawing) of the transverse expansion joints were removed and the cork expansion joints for the brick were set in from a platform on the rear of second finisher. This completed the mechanical finish of the concrete which was then hand-finished with a long handled float, then checked and finished with a ten-foot straight edge, working out any high spots which might be found.

Brick Forms.—The 3½-in brick forms, on which the brick vibrating, the brick roller carriage and the grouting machines traveled, were then set on the top of the base forms, clamped and braced securely. These forms originally were curb forms and were far too light for the brick vibrating machine. A plate was welded in the back of these forms and three 2 in. angle clips were welded on the plate, each with a rivet welded to it. A pointed stake and an arm made from 2 in. angle iron were loosely bolted together. The stake was driven into the ground, the arm hung over the rivet and the nut tightened. Three of these braces were used for each ten-foot length of form.

Brick.—The brick was furnished by Metropolitan Brick Co., of Canton, Ohio. Mr. Warren Barr, and Mr. Henry Wuske of the company donned their working clothes and were on the job every day, assisting in all brick operations.

The brick were wire cut, lugged, and were laid flat. Ninety-five per cent of the brick were handled directly from the trucks. A platform was built and hung to the side of the truck, about 18 in. above the ground, to make it easier for the men handling the brick to the conveyors. The conveyor consisted of a double set of rollers, one going to the center of the road and the other to the opposite side. The brick were laid from one side to the center and from the center to the opposite side. The batting, culling, and spacing naturally followed. The bricks were laid on the wet concrete and laid rather loose, to allow for better grouting. The brick-layers and others walked directly on the newly laid bricks but it was soon realized that it was best to keep moving and not to congregate in groups. The bricks were then swept clean and ready for the vibrating machine.

This machine, like the first, was powered by a gasoline engine generator set. The four vibrating units were also the same as those on the first machine. The vibrating surface was formed by eighteen 12 in. by 60 in. channels, spaced side by side and suspended as a unit from the main frame. The machine moved forward slowly and with intermittent pauses, to prevent the pos-


Edge of shoulder
31.25' from ℄ roadway
26.4' from ℄ roadway
Intercepting Ditch
2:1 slope
5'-0" c to c
14"x14" openings 5' on centers in this course.
Ditch paved with salvaged paving brick rt. and lt. sta 46+00 to 55+94 Grout filler
3.0'
Edge of shoulder.
Rip-rap constructed of salvaged concrete curb
3'-0"
3'-0"
Side ditch paved with salvaged brick and grout filler.

Showing Paved Intercepting Ditch. First of Kind in Ohio.

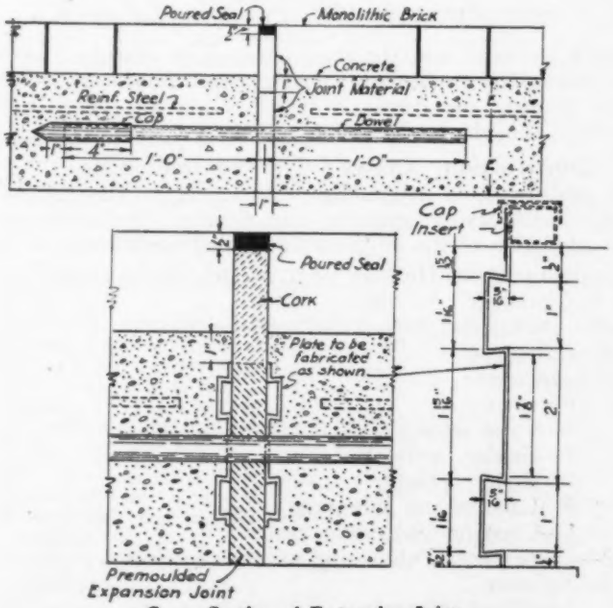
sibility of dragging. The average penetration of the brick into the concrete was ⅛ in., forcing mortar up between the brick from ¼ in. to 1 in. Approximately 927,000 bricks were used, 3,000 bricks to the load.

A bumpometer was used to check the pavement. The vibrating machine was brought back for the second vibration *only* if an appreciable area of high spots were found.

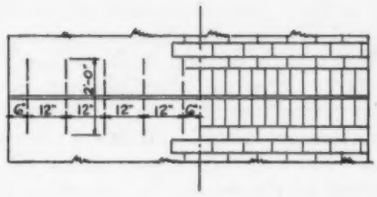
Grouting.—A unique grouting machine was assembled by the contractor and proved very satisfactory. A small non-tilting mortar mixer with water tank, gauge and timer, made by the Construction Mchy. Corp., Waterloo, Ia., was mounted on an old Lakewood finishing machine frame. A plank walkway was built to each side on the front to give access to the hopper. A

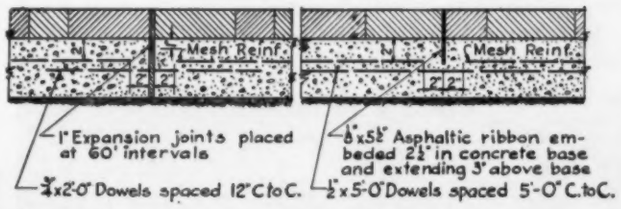
Grouting Machine Developed by Contractor Vogt. Note Grouting Is Complete and Wet Burlap Strips Placed for Curing

swinging spout was made and hung on the back. Water was furnished by a hose connection to the water line along the road. A short piece of hose with a spray nozzle was connected to wet the bricks just before the 1 to 2 grout was applied. The sand for the grout was weighed and sacked at a central location, in old cement sacks, 65 lb. to the sack. One sack of cement and three sacks of sand were used in each batch. Six bags of cement and eighteen bags of sand were stacked on slat racks at 30 ft. intervals along the portion of the road to be finished that day. The first application of grout was made thin and worked in slowly with a diagonal squeegee stroke for a distance of about 150 ft. This



Cross Section of Expansion Joint




Mesh Reinf.
Mesh Reinf.
1" Expansion joints placed at 60' intervals
8"x5½" Asphaltic ribbon embeded 2½" in concrete base and extending 3" above base
¾"x2'-0" Dowels spaced 12" C to C.
¾"x5'-0" Dowels spaced 5'-0" C. to C.

Showing How Brick Were Laid Along Both Transverse and Longitudinal Joints

was left to settle for an hour or more before the second application of heavier consistency was applied. This was again left to settle and finally a wide burlap strip was dragged over it lengthwise, wetting the burlap from sprinkling cans as it was dragged. This filled all remaining crevices nicely and left a good appearance. A rather coarse sand was used at the start but soon was changed to a finer sand, which worked out much better. Both grades were within the limits of the specifications.

Showing the Transverse Joint Assembled Ready to Be Installed

The pavement was then covered with burlap which was replaced with straw the following morning.

Expansion Joints.—Non-extruding transverse expansion joints, 1 in. thick, were placed in the base every sixty feet. These were assembled complete on the job in two section or halves and set to place about 3/16 in. below the top of the base forms and center of crown, to allow the machines to work over them freely. They were set solid and to line and blocked in place on both sides with concrete placed with shovels. Tin sleeves were used on one end of the dowels which were 12 in. on center. The cork expansion joint mentioned before, was set on this joint and came within a half inch of the surface of the rick. Later, these open joints were filled, or rather over-filled with a hot composition filler and cut flush after cooling. Reference to the cross section and picture of this joint will explain it better than words.

The design and detail of the transverse expansion joint is an important consideration in the proper functioning of the pavement. The bituminous sandwich material of the joint is punctured with holes like a slice of Swiss

cheese. The theory is that, upon expansion of the slab, the sandwich joint will compress without extrusion.

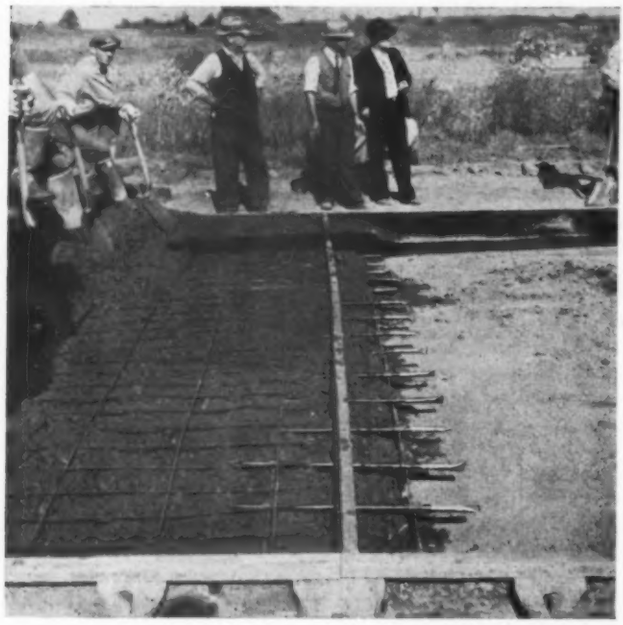
When the joint is set, it is capped with a filler and metal sleeve to protect it while the finishing is in process. The finishing workmen remove the metal cap and filler before the brick are placed and insert the cork portion of the joint. Since the cork part lacks ⅜ in. of reaching the surface of the brick, the grouting naturally fills up this depression. However, next morning it is dug out before the grout sets too hard and is then later poured with bituminous joint filler.

Structures.—Mention might be made that two box culverts were built. One 7 ft. by 9 ft. by 150 ft., carrying a fill of 25 ft.; another 9 ft. by 12 ft. by 130 ft., carrying a fill of 14 ft.

Bituminous Longitudinal and Cork Transverse Joints in Place as Brick Droppers Approach

An attractive rip rap wall was built on a fill slope on the inside of a curve where the road touches a canal for a distance of 350 ft. This wall was built in 20 steps on a 1 to 1 slope, from 6 ft. lengths of old concrete curb and braced at the bottom by 20 ft. piling which will be covered with water after the canal is refilled. The paved intercepting ditch is the first of its kind in the state.

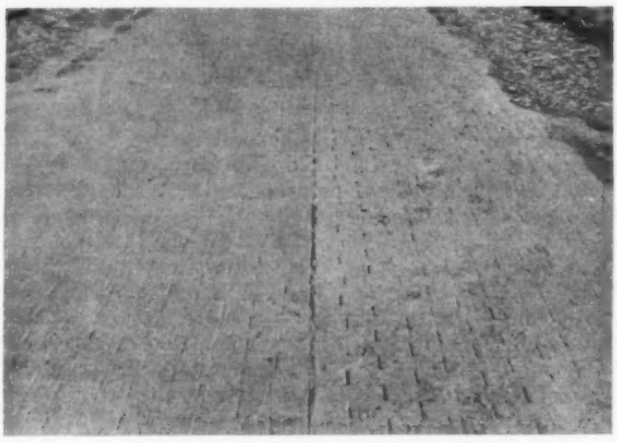
Working Days.—The contract was taken on the basis of completing the work in 150 working days. A working day was based on the number of men working. Work was started May 25th, 1938. Up to October 18th, 87 days were counted as working days or 57 per cent of the time allowed. The excavation structures and pavement have been completed, comprising 85 per cent of the total contract.



Transverse Joint and Bar Mat in Place. Note Dowel Sleeves.

The pavement was started on Sept. 3, 1938, and finished on Oct. 17. Twenty-seven days in all were used. Twelve days were lost because of rains. On eleven days 480 ft. of pavement were laid; on 6 days 540 ft., and on three days 600 ft. were laid.

Progress Chart.—A progress chart was kept on a large piece of ¼ in. cross-section paper. On the upper part of the chart, separate columns were arranged for each bid item so that the percentage completed of each item with dates could be shown by filling in with red pencil as the work progressed. At the top of the columns the item number was shown with a short description of the item. At the bottom of the chart the estimated amounts were shown. Other columns showed the same information as to grouped items, such as: Roadway, Pavements, Structures and Improvements. On the lower portion of the chart a running calendar schedule was shown. This was arranged in shorter columns giving days and dates from May 20 to Nov. 30. Spaces were arranged to show or indicate the weather, maximum and minimum temperatures, the number of men working, and the days counted as working days, consecutively numbered. Large headed pins were stuck in showing the items on which work was done that day. This chart was found to be very convenient.



Surface Appearance After Straw Partially Removed

Construction Crews.—The contractor had his crews organized on grading, form setting, batching, mixing, brick laying, grouting and cleanup. Following is a tabulation of the setup on the paving operations:

Superintendent, Herman Vogt, brother of the contractor
3—Foremen
30—Skilled and semi-skilled workmen
40—Laborers
Arrangement:
1—Foreman
2—Form setters
2—Grader operators
1—Roller operator
9—Laborers on sub-grade
1—Cleaning and oiling forms
2—Carpenters—Fabricating expansion joints
1—Foreman
1—Mixer operator

4—At mixer—handling bar mats and expansion joints
2—Loading cement sacks
2—Emptying cement sacks
4—Puddlers
1—Operator—First finishing machine
1—Operator—Second finishing machine
1—Placing center joints on second finishing machine
2—Cement finishers
10—Handling brick
3—Brick batters
4—Culling and spacing
1—Operator brick vibrating machine
1—Foreman
1—Operator grout machine
2—Handling material
3—Screeding grout
2—Sprinklers
3—Truck drivers
2—Helpers
1—Pump operator
5—Brick trucks—averaged 16 mile haul
7 to 9—Batch trucks—averaged 5 mile haul

Laborers were paid a minimum of $0.65 per hr. Skilled and semi-skilled workmen were paid $0.75 to $1.37½ per hr.

Following are estimated quantities for the total contract and bid prices on the various items as submitted by the contractor:

	Total Contract	Bid Price	Unit
ROADWAY—			
Roadway excavation (unclassified)	100,560	$0.33	cu. yd.
Finishing shoulders, slopes and ditches	11,588.2	.30	lin. ft.
Removal and disposal of existing brick on concrete base	22,510	.23	sq. yd.
Trees and stumps removed and disposed of	64	7.00	each
Watering embankments (estimated)	349,000	3.50	M gal.
12″ corrugated metal pipe Sec. M-6.4 (a) b-1 for driveways	460	1.30	lin. ft.
12″ vitrified sewer pipe Sec. M-6.8 (b) for roadway drainage including porous backfill	3,064	.96	lin. ft.
18″ vitrified sewer pipe Sec. M-6.8 (b) for roadway drainage	384	1.39	lin. ft.
12″ reinforced concrete pipe Sec. M-6.6 (b) for roadway drainage under drives	410	1.35	lin. ft.
6″ extra quality drain tile Sec. M-6.7 (b) for underdrains	3,000	.45	lin. ft.
12″x12″x6″ Y pipe specials	70	2.25	each
12″ vitrified sewer pipe removed and stored	766	.40	lin. ft.
Concrete for steps, 1-5½ mix	11.1	18.00	cu. yd.
Standard No. 1-2 catch basins	2	50.00	each
Standard No. 1 side ditch inlets	22	25.00	each
Bench marks as per plan	4	20.00	each
Monument boxes as per plan	15	20.00	each
Stone underdrain (French drain) No. 2	5,000	.15	lin. ft.
Salvaged curb hand-laid riprap as per plan	2,469	.75	sq. yd.
6″ concrete sidewalks (one course construction)	360	.35	sq. ft.
Salvaged brick gutter as per plan.	9,186	.45	lin. ft.
Guard rail removed and stored	2,451	.10	lin. ft.
Aggregate for traffic bound side approaches and mail boxes	339	2.25	cu. yd.
PAVEMENT—			
9″-7″-7″-9″ reinforced Portland cement concrete base course	25,759.1	1.48	sq. yd.
3″ monolithic brick surface course, complete	25,759.1	1.51	sq. yd.
STRUCTURES—			
(20 ft. Span and Under)			
Excavation for structures (unclassified)	1,109	1.25	cu. yd.
Channel excavation	814	.60	cu. yd.
Concrete for footings, 1-6½ mix	32	14.00	cu. yd.
Concrete for culverts, 1-5½ mix.	609.4	18.00	cu. yd.
Waterproofing Type B	156	1.60	sq. yd.
Reinforcing steel	101,412	.05	lb.
Removal of portions of existing masonry	10.9	4.00	cu. yd.
Dowel holes 1″ diameter	6	1.00	lin. ft.
12″ reinforced concrete pipe Sec. M-6.6 (b) for roadway culverts.	46	1.25	lin. ft.
18″ reinforced concrete pipe Sec. M-6.6 (b) for roadway culverts	225	2.00	lin. ft.
Standard No. 6 catch basin	1	60.00	each
8″ grout filled hand-laid riprap using salvaged brick	40	2.00	sq. yd.
12″ reinforced concrete pipe removed and stored	31	.35	lin. ft.
12″ cast iron pipe removed and stored	48	.40	lin. ft.
ROADSIDE IMPROVEMENT—			
Pruning existing trees 8″ to 15″ caliper	16	4.25	each
Pruning existing trees 16″ to 24″ caliper	16	6.00	each
Pruning existing trees 25″ to 30″ caliper	5	10.00	each
Pruning existing tree 34″ caliper.	1	12.00	each
Stone riprap for tree protection (salvaged curb)	138.9	1.00	sq. yd.

Left to right: W. L. Belknap, Resident Engineer, Ohio State Highway Dept.; Frank McCaffrey, Sales Mgr., Flexible Road Joint Machine Co., Warren, Ohio; Elmer Vogt, Pres., Elmer Vogt Paving Company, Massillon, Ohio; W. L. Barr, Metropolitan Paving Brick Company, Canton, Ohio; L. R. Luke, Project Engineer, Ohio State Highway Dept., Canton, Ohio; at right in background, Herman Vogt, Supt., Elmer Vogt Paving Co.

Aggregate for tree aeration	8.7	4.00	cu. yd.
Erecting and maintaining lights, signs and barricades	lump	300.00	lump sum
Premium on Industrial insurance.	lump	2,090.05	lump sum

State Forces.—The work is under the supervision of the Ohio State Highway Dept. The following are those responsible:

A. E. Ranney, Division Engineer; Geo. Holman, Asst. Div. Engineer; W. L. Belknap, Resident Engineer; L. L. Luke, Projecting Engineer; Howard Rupert, Materials Engineer; 2 Timekeepers, 1 Inspector at aggregate plant, 1 Material checker, 1 Concrete inspector, 2 Brick inspectors, 1 Grout inspector.

This is the most completely mechanized brick paving job in the United States. The road has given the countryside a new appearance with its long sweeping curves, its wide right of way and long sight distances compared to the old narrow kinky road which it has replaced. Traveling through a cut of 22 ft. and over a fill of 35 ft. one realizes the effort that is being put forth to make a highway out of a road. The minimum curvature used was 2 degs. and the maximum grade was 2.5 per cent.

SOILS SURVEYS FOR HIGHWAY PURPOSES

The Pedological System for Classifying Soils as Employed by Michigan State Highway Department

By O. L. STOKSTAD
Engineer of Soils, Michigan State Highway Department, Lansing, Mich.

ONE of the firt steps in the study of any subject involving a large number of separate units consists of becoming sufficiently well acquainted with the individual units to recognize traits or characteristics which they may have in common, and thus have the information necessary to develop a logical system of classification.

The soil is composed of a large number of soil individuals and, because it is one of the important factors influencing human institutions, considerable thought and study has been given to its classification. Early attempts at classification were largely utilitarian in character. A method for grouping, for instance, may have been based on the capacity of the soil for the production of wheat. It is only in recent times that the soil has been recognized as a natural body, the characteristics of which occur with sufficient orderliness to permit their use as a basis for classification. The technique of classifying is now well developed and it is only necessary for a highway engineer to familiarize himself with existing methods to make available a source of information which, up to the present time, has not been exploited by the majority of road builders.

Fig 1

MICHIGAN STATE HIGHWAY DEPARTMENT
SOIL SURVEY
Southern Group
Bellefontaine Series
Sandy Loam Type
Profile and Description
Remarks
Litter, leaf mold, and humus soil.
Ranges in texture from a sandy loam to a loam.
Yellowish brown friable sandy loam.
The Bellefontaine is distinguished from the Fox by a greater variation in thickness of the "B" horizon together with the presence of stone, boulders, and clay pockets in the substratum.
Reddish brown slightly compact sandy loam. Made coherent by a small amount of sticky clay.
Occurs mainly on moraines.
A confused mass of sand, sandy clay, silt, gravel, and boulders.

Fig. 1—How the Units Are Described for Field Identification Purposes

Soil Surveys Using the Pedological System of Classification May Be Made at Any Time of the Year. This Picture Was Taken During the Lunch Period on a Soil Survey in the Keweenaw Peninsula of Upper Michigan in January.

Highway engineers in the course of their activities acquire a large amount of miscellaneous information about the various soils with which they come in contact. This information is of little value to the highway profession in general, so long as it is not associated with definite soil individuals. What profit to know that one road builder went bankrupt because of grading difficulties, if these difficulties are not associated with definite soil units which can be recognized when encountered on future work? Laboratory test results will also prove of greater value if, in addition to revealing properties of a sample of soil material, they also provide general information as to what can be expected of a given soil type whenever and wherever encountered. This is only possible when test results are definitely associated with individual soils recognized on the basis of their own characteristics. In other words, the first thing to do in a systematic study of soils is to classify the soils, and thus simplify one of the natural sciences, which at first glance looks both bulky and complicated. Only in this way can we supply soil knowledge to engineering problems without an infinite amount of sampling and testing. In other words, relate test results and all other soil experience to some unit of soil classification, and thus build a source of information which will increase the efficiency of the engineering staff, lengthen the life of the resulting road and improve the quality of service from both.

Of the various methods used for classifying soils, the Michigan State Highway Department has found that the pedological system is the most useful.

Test Pitting for Ledge Rock After the Soil Classification Survey Was Completed. The Soil Classification Indicated Where to Check for Rock.

The Pedological System

This system of soil classification is based on characteristics of the soil profile, and on the basis of these characteristics, soils are separated into zonal groups, series and types; the soil type being the unit of classification used in making detailed soil surveys. Figure 1 illustrates the manner in which these units are described for field identification purposes. For more detailed information on the pedological system of classification, refer to Miscellaneous Publication 229, U. S. Department of Agriculture, Washington, D. C., "Development and Significance of the Great Soil Groups of the United States," by C. E. Kellogg.

In discussing soil activities with a wide awake highway engineer, the general aspects of the subject are soon abandoned as the discussion settles down to specific questions, the more common of which are listed below:

1. Of what should soil surveys consist?
2. What are methods of operations?
3. What is the technique of organizing and initiating a system of operation?
4. Can a technique evolved elsewhere be used without preliminary development work?
5. How much detail should be attempted in making soil studies?
6. Is it feasible for units smaller than a state highway department to equip for soil investigations?
7. What returns may be expected from an investment in a soil survey organization?

A Modern Soils Survey for Highway Purposes

Classifying the soil should be the first step in the study of soils for highway purposes. There are two reasons why this is true. First of all, the technique of classifying (if the pedological system is used), forces the operator to become thoroughly acquainted with the soil. This acquaintanceship includes a complete and well organized picture of foundation conditions to be encountered on the proposed construction project. The experience of classifying, therefore, makes an alert soil technician a particularly valuable consultant in the preparation of plans and in the solution of grading problems.

Secondly, the soil survey in classifying the soil serves as an inventory of soil material resources; it indicates the proper use of these resources; it definitely locates where further problems are likely to be encountered, and indicates what further investigations are necessary for the solution of these problems. By being based on characteristics of the soil, the classification indirectly supplies information as to its properties and indicates when additional laboratory work is necessary to supply more specific information with respect to these properties. A modern soil survey, therefore, includes a soil classification, borrow inventory, rock soundings, peat soundings, drainage information, erosion information and, of late, there is even a tendency to include an inventory of native plant material for use in healing construction scars.

Method of Operation

Making soil surveys is a relatively simple matter. The personnel may be limited to one man and the physical equipment may consist of preliminary road plans or cross section sheets on which to map, a soil legend, soil auger, trench pick, tile spade, peat sampler; and sufficient stamina to effectively use these tools.

The field investigation consists, first, of making the soil classification map on which is shown the soil names and soil boundaries. Other information may also be shown, the amount of which depends on whether or not road plans are available for the work. If cross section sheets are used, a certain amount of base data is shown to assist in transferring the soil survey to the plan sheets. The information shown on the soil maps has never become completely standardized, mainly because of the fact that no two projects are exactly alike. This continuous variation so characteristic in nature stimulates the imagination of the experienced soil technologist with the result that he is quickly aware of new soil, drainage and other complexes likely to influence design and construction. There is constant variation, therefore, in the information shown on the map as well as in the construction of the map itself.

In mapping soils the operator does not blindly dig a series of holes along the center line of a proposed project in order to determine soil boundaries. First of all, he sizes up the country in general, and from observations on drainage, topography, vegetative cover, stoniness, agricultural utilization and geographic location, he knows what soils or soil complexes will likely be encountered. The determination of the soil type and its boundaries is then accomplished by examining exposed cut sections and by digging a few judiciously placed auger or spade holes. There are a number of formations or conditions uncovered by the soil survey which receive special attention. These are swamp deposits, filled in valleys, shallow ledge rock, shallow water table and clay depths in sand soils.

Soil studies for highway purposes are principally a field study, but, as investigations progress, the need for a laboratory will become apparent. This need not be elaborate unless extensive research in soil chemistry, soil physics or soil mechanics is planned. There should be facilities for making grading analysis and the more

What a Soil Name May Indicate to the Designing Engineer. Typical "Posen Stony Loam" Profile

What a Soil Name May Indicate to the Designing Engineer Borrow Pit Backfill for Peat Excavation.

common tests previously described in ROADS AND STREETS. The important fact to remember is that results from laboratory tests can have only limited usefulness unless associated with some soil unit used in classifying soils. In other words, the soil type should be the means of classifying all soil information, including laboratory test results.

Operating methods do not end with the preparation of information for design purposes. After the project has been placed under contract, the soils engineer must examine new exposures in cut sections to identify destructive soil textures which should be removed, bad drainage conditions to be corrected, and generally consult with the engineer in charge of construction relative to the most effective use and treatment of soil materials encountered during grading operations.

The Technique of Organizing and Initiating a System of Operation

It is important that the job of specializing in foundation studies be given a man of long experience and thorough education, either in soils or in highway engineering. A thorough training in either one of these professions enables the operator to quickly learn enough of the other to function effectively.

One of the first activities to be undertaken by a newly organized soils division will consist of assembling as complete a legend as possible for the soils of the area in which they will operate. A complete file of all county soils surveys is necessary. These will contain detailed descriptions of the soils encountered in the respective counties and will, therefore, be an excellent source of information for preparing the legend. If the area to be covered by the soil engineer has only a few or no county soil surveys available, it may be necessary to recognize or establish new soils not yet identified. This may be accomplished through cooperation with the soils department of the local university and the bureau of chemistry and soils. County soil survey activities are in operation in a number of states during each field season and offer opportunities, therefore, for an inexperienced man to learn, first hand, the technique used in making soil maps.

In order to study the influences of soils on highway behavior, it may be necessary to make soils surveys and highway condition maps along highways on which the metal has been in place sufficiently long to permit foundation conditions to be reflected in pavement behavior.

The most important result of a survey or study of this type will be the training and experience acquired by the field worker. If projects thus studied are widely distributed, he will have an opportunity to learn at first hand the influence of widely varying soil conditions on the length and quality of service of road surfaces. Based on this experience, he will be able to begin the development of charts containing soil information for deisgn and other highway purposes. The length of time necessary for a new soils organization to become efficient in its operations depends upon the size of the area to be covered. Obviously, to become acquainted with soil problems in a single county would be far simpler than to accomplish the same thing for an entire state.

Preliminary Development Acitivities

Any system of classification used should be sufficiently flexible to make application to new conditions simple. Every locality has problems characteristic of itself, and it is usually not practical, therefore, to attempt methods used elsewhere without variations to meet local conditions. For general soil survey work, however, the pedological system as used by the Bureau of Chemistry and Soils is recommended. This system involves field studies and, for that reason, is particularly well adapted to highway needs which should also consist primarily of field investigations. Many attempts at soil studies for highway purposes have failed because of the belief that these studies consist of miscellaneous laboratory tests performed on random samples of soil materials. The time is not far distant when the highway engineering profession will find it necessary to adopt a uniform comprehensive system of soil classification based on characteristics of the soil. In no other way can there be a common ground on which highway engineers can discuss their soil problems without confusion and consequent misunderstanding.

Amount of Detail to Be Attempted

The immediate reason for organizing a soils survey personnel may be the need for studying the quality of clay for stabilizing purposes or for examining foundation conditions in a "sink hole." As experience is gained, however, the amount of work performed by the soils organization will increase rapidly. It soon becomes evident that, no matter how well designed the metal may be, it fails to render efficient service if its foundation is faulty. The new service must expand, therefore, to include the study of foundations.

Experience seems to indicate that the amount of information which may be supplied by a soil survey organization is limited only by the capacity of the organization to recognize critical information and by its ability to present this information so that it may be used by research, design, construction and maintenance engineers.

Examining the Subgrade for Frost Heaving Textures or Bad Drainage Conditions.

Size of Unit Which Can Economically Use a Soils Organization

Inasmuch as expensive equipment is not absolutely necessary, there is no economic limit with respect to the minimum size of highway organization which can afford to make soil surveys. It is remarkable what a wealth of information is available to the highway engineer who will take the trouble to investigate below the ground surface.

The most important mental equipment necessary to make such invistigations is an acquaintanceship with the soils of the section and the smaller the unit the simpler this requirement becomes. A county highway organization, for instance, could well afford to have some member of the technical staff spend part time specializing in soils.

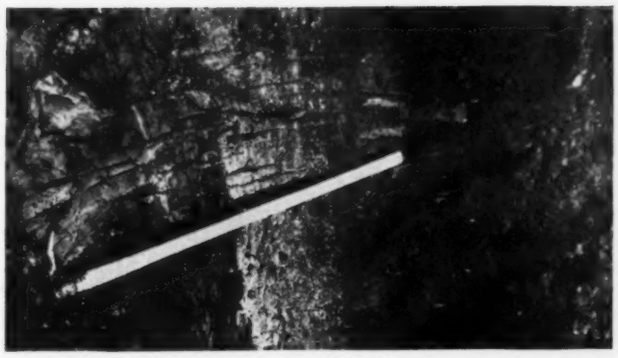
The important point is to get started. The technique to use will soon become evident once sufficient interest has been roused to overcome the inertia involved in getting under way.

Utility of Soil Surveys

For the sake of brevity the usefulness of a soil engineering organization to the functions of design, construction maintenance and research will be presented in outline forms.

I. HIGHWAY DESIGN:
1. Highway location
   a. Swamp studies
   b. Rock information
   c. Land use information
2. Design of grade line
   a. Water table
   b. Clay depths
   c. Elevation of bed rock
   d. Storm water run off
   e. Conditions to be encountered in cut sections
3. Cross section
   a. Type and size of ditches
   b. Cut and fill slopes to be used
   c. Shoulder treatment
   d. Sub base design
4. Drainage structures
   a. Bridge and culvert foundations
   b. Location and size of tile
5. Swamps
   a. Soundings
   b. Method of peat displacement
   c. Type of surfacing
6. Materials inventory
   a. Borrow
      (1) Location—sand, clay
      (2) Amount
      (3) Character
   b. Gravel resources
      (1) Location
      (2) Sampling
      (3) Testing

A Soil Classification Provides Information as to What May Be Expected in a Deep Cut as Here Shown.



Peat Deposits Must Be Studied in Order That a Stable Embankment May Be Constructed Economically.

   c. Clay deposits
      (1) Location
      (2) Sampling
      (3) Testing
7. Embankment
   a. Compaction
   b. Proper use of various soil materials
8. Erosion
   a. Location and extent of problem
   b. Treatment
9. Metal
   a. Thickness
   b. Type

II. CONSTRUCTION:
1. Subgrade inspection
   a. Frost heave
   b. Drainage
   c. Sub-base
   d. Laboratory test results
   e. Stabilization
2. Borrow
   a. Inspection of material
3. Consulting capacity with respect to
   a. Fill compaction.
   b. Swamp construction
   c. Erosion control
   d. Foundation for drainage structures
   e. Interpretation of soil information on plans

III. MAINTENANCE:
1. Study of failures
   a. Frost heaves
   b. Spring break up
   c. Evaluation of soil factors
   d. Test results on samples
2. Stabilization of gravel
   a. Location of suitable clay
   b. Test results on samples

IV. RESEARCH:
1. Laboratory
   a. Development of new methods
   b. Test results
2. Reports
   a. Construction experience
   b. Research projects
3. Consulting
   a. Selection of sites for experiments
   b. Location of specific soil materials
   c. Evaluating soil factor

▼

GASOLINE TAX REVENUES INCREASE IN NORTH CAROLINA—Revenues from the North Carolina gasoline tax of 6 ct. a gallon and from the inspection tax of ¼ ct. a gallon increased $1,241,578 during the fiscal year 1937-38 over the fiscal year of 1936-37. The total highway fund revenue from all sources including gasoline tax, automobile licenses, title fees and so forth for the fiscal year ending June 30, 1938, amounted to $31,948,299, while the revenue from these same sources for the year ending June 30, 1937, amounted to $31,094,401. These figures do not include the revenue from the inspection tax of ¼ ct. a gallon.

A PORTABLE AUTOMATIC TRAFFIC RECORDER

THE portable automatic traffic recorder described below was developed by the State Wide Highway Planning Survey of Texas. Valuable assistance in perfecting the recorder was furnished by the School of Physics and the School of Electrical Engineering of the Texas Agricultural and Mechanical College and also by the School of Electrical Engineering of the University of Texas.

This portable automatic traffic recorder is built around the photo-electric tube commonly known as an "electric eye." A block diagram, Fig. 1, shows the general scheme of operation. Light rays from a battery operated electric bulb shine across the highway upon a photo-electric tube, causing it to conduct current. This current passing through a very high resistor produces a grid bias voltage which stops the flow of current through an amplifier tube. When this light beam is broken by a passing vehicle, the current through the photo-tube ceases, and no blocking voltage is produced to prevent the flow of current through the amplifier tube. Consequently, a relay in the amplifier plate circuit is energized, operating an electromagnetic register. Thus, each passing car causes the register dials to advance one digit. A clock operated camera takes a picture of the number on the dials of the register on each hour of the day. The photographic film is the permanent record of the hourly traffic over the highway.

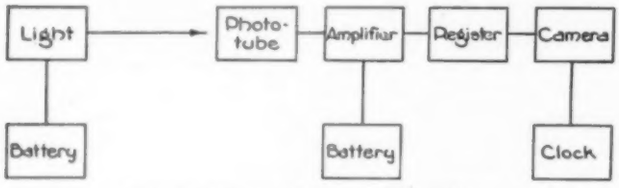


Fig. 1—General Scheme of Operation

The entire counter is battery operated in order that it may be used any place on any highway. A 3-candle-power automobile dash bulb in a standard automobile spotlight is used as the source of the light rays that shine across the highway. This light source operates the photo-tube and register continuously at a distance of 85 ft. for 6½ days from a 90-ampere-hour battery or for 8 days from a 120 ampere-hour battery.

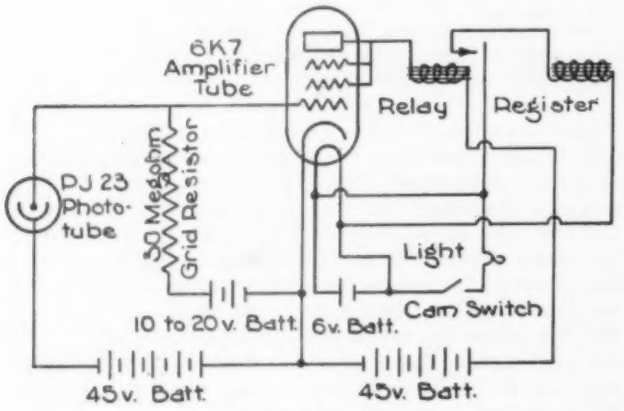
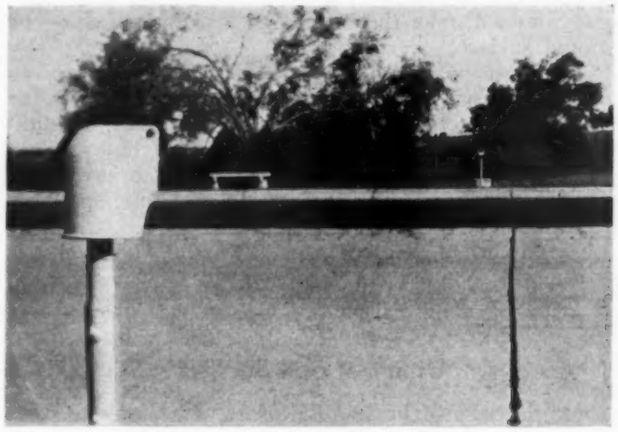


Fig. 2—The Circuit



Set-Up of Portable Automatic Traffic Recorder on Highway

The amplifier circuit is different from the usual photo-tube circuit in that, when light is falling on the photo-tube, no power is used except to heat the filament of the amplifier tube, since the plate current is blocked and the relay contacts open. This circuit is shown in Fig. 2. The light rays are focused by a 4-in. condensing lens upon the plate of a General Electric PJ23 photo-tube through a ⅛-in. diameter hole in the cover for the photo-tube. This cover eliminates a very large portion of the sunlight which otherwise would assume control of the photo-tube. When the photo-tube is conducting current, it changes the grid bias on the amplifier tube, a General Electric 6K7 pentode connected as a triode, from a fixed plus potential to a negative potential by causing a negative voltage drop across the grid resistor. This negative grid bias blocks the amplifier tube. However, when a passing car breaks the light beam, the photo-tube ceases to conduct current, the grid bias becomes positive, and the amplifier tube conducts current operating the relay in the plate circuit. The relay contacts close the circuit of a 4-digit electromagnetic register and battery. An optimum value of positive fixed grid bias must be chosen for continuous day and night operation without change in adjustment.

Photographic Film Recording Traffic

Each hour a cam mechanism on the minute shaft of a power clock closes the electric circuit to a small flash light bulb, in the camera end of a light proof tunnel

between the register face and the camera lens. The shutter of the camera is open at all times and the light thus exposes the film. Between exposures, the film is rolled about ¼ in. by a gear meshing with the main spring gear of the clock. Twenty-four exposures occupy only 4½ in. of 32 mm. movie camera film so that an 8-day count can easily be obtained on a standard 5-ft. length roll of film. The amplifier and register operate 8 days or longer off a single standard 90 ampere-hour storage battery. As the clock also runs approximately 8 days, this traffic counter is conservatively called a portable, 7-day automatic traffic counter.

A comprehensive program of highway planning requires a knowledge of traffic throughout the year on every mile of road in the State.

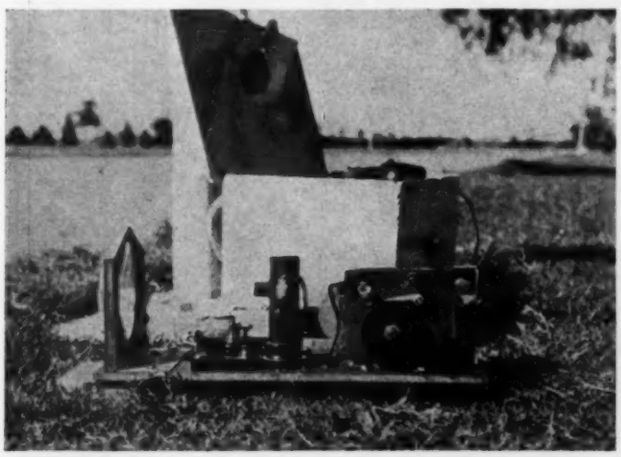
Since there are in Texas approximately 186,000 miles of roads, it is necessary to rely upon short counts spaced at considerable distances apart on the roads. At a great many points, it is necessary to rely upon single 8-hour counts. Some of these counts are made at seasons of heavy traffic, others at seasons of light traffic. In order to tie these counts together into a picture of the traffic volume for the year, it is necessary to have some continuous counts, also some seasonally spaced counts. The relation between the week-day traffic and the week-end traffic must also be determined.

In Texas, in the last two years, 22,006 traffic counts have been made at 12,955 stations on the state highways and the county roads. This traffic survey has provided a fairly complete picture of the use that is being made of the roads today.

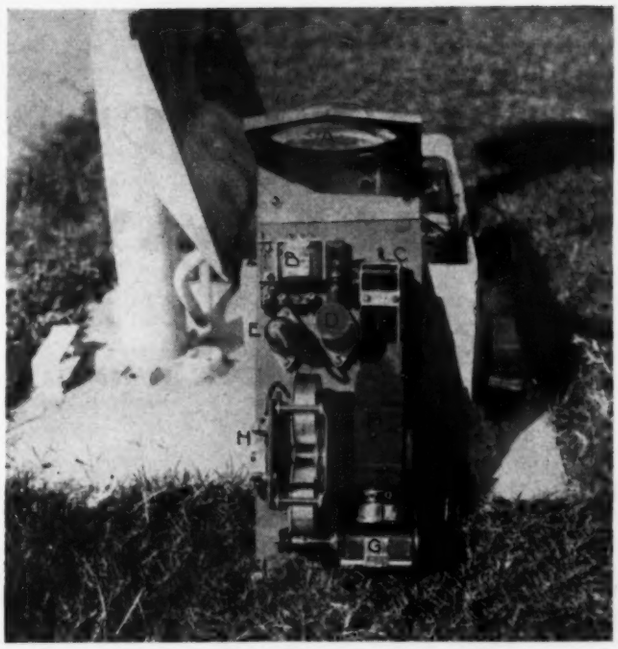
In order that this information may be kept up to date, it will be necessary that check counts be made at numerous representative stations to obtain the variations in density and traffic patterns which occur from year to year.

There are now installed in Texas at permanent stations, 20 automatic traffic recorders which were purchased from the International Business Machines Corporation. They will record the variations in traffic density and pattern in their immediate areas. Additional counts varying in length of period from 24 hours to a week or two at a station will supplement this information and provide data which will keep alive the information gathered by the recently completed traffic survey.

The portable automatic traffic recorder described in the preceding paragraphs is ideally suited to this purpose. It will serve to bridge the gap between the single short counts secured manually and the continuous counts provided by the permanently installed recorders.



Assembled Parts of Portable Automatic Traffic Recorder



Details of the Portable Automatic Traffic Recorder
A. Condensing Lens. B. Sensitive Relay. C. Weston Electric Message Register. D. G.E. PJ23 Phototube. E. 6K7 Amplifier Tube. F. Light Proof Tunnel. G. Argus Camera with Special Lens. H. Eight-day Seth Thomas Power Clock with Hour Contact.

It will operate unattended for eight days. It is independent of commercial power for its energy. It is easily transported, and can be installed by one man in 30 minutes. The recorder can be built for approximately $125.00. While the cost of operation varies with the frequency of set-ups, it might be safely stated that using an 8-hour count as a unit, the automatic traffic recorder may be operated at from 10 to 25 per cent of the cost of the manual count.

The portable recorder permits a wide range in operating schedules. It may be used in groups of three or four with one caretaker, or it may be used in conjunction with manual short counts in the same area and supply 24-hour expansion factors to the short counts.

Aiding in construction of a 10-mile stretch of highway in eastern South Dakota is this 12-yd. LeTourneau Carryall, owned by David Gustafson, Sioux Falls contractor. The unit, equipped with U. S. Royal Earthmover tires, and pulled by a Caterpillar RD-8 tractor, is one of a group operating on two 7-hour shifts removing 240,000 cu. yd. of dirt.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ One bit of information picked up at the Bituminous Conference at Biloxi is that the Mississippi Highway Department is now planning to by-pass certain towns where congestion is most troublesome both to through traffic and local business. Some storekeepers still object, but the majority know that the main drag drives away more business than it brings. More power to you, Mississippi.

• •

¶ The downtown area of Vicksburg, Mississippi, has some excellent brick pavement with bituminous filler. Not only are its riding qualities of best, but color and texture are highly pleasing to the eye, the herringbone lay at intersections being especially attractive.

• •

¶ Do you ever notice the weird effect of your headlights on aluminum-painted trusses? How, though the vertical members stand out brilliantly white, the diagonals and other surfaces seen at an angle, are black? An unimportant trifle, yes; but it adds interest to driving.

• •

¶ It is reported that the State of Kansas is contracting considerable amounts of its maintenance work, and finds the method economic. It is also reported that the engineers are a bit harder boiled with the contractors than with their own superintendents and foremen. Successful contracting of maintenance is reported also from Iowa.

• •

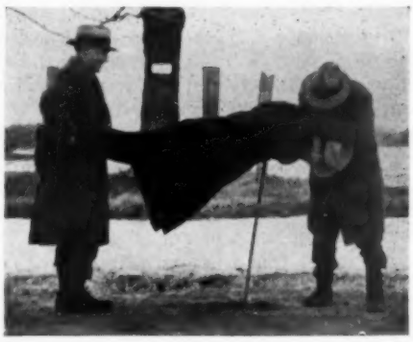
¶ What is a "seal coat?" I find people using the term to indicate most anything from a simple shot of ¼ gal. tar or asphalt per square yard, with or without cover, to a 2-in. layer of premixed material. The words seem hardly expressive of the latter.

¶ We noted the question in the "Puddle Jumper" page about the dissemination of research information and new equipment developments. It seems to us that the best way of getting this story across quickly is in advertising, probably through the use of case histories.—Geo. McNutt, Milwaukee, Wis.

• •

¶ In this one picture you see three new ideas (and they are not leaning up against the machine, either). (1) The machine is a grout mixer that rides on forms. It was built out of a pair of old Lakewood finishing machine forms by Elmer Vogt, contractor of Massillon, Ohio. (2) The extra form placed on top of the concrete base forms is a new idea and note how they are held firm by stakes. (3) Laying over on the grass is a checking template. It is made like a truss and rides on the base forms. McCaffrey of Flexible Road Joint Machine Co. seems to be paying more attention to the camera than to the job. Watch what's going on, Mac.

¶ Human auger handle drilling through frost heave. This is not a



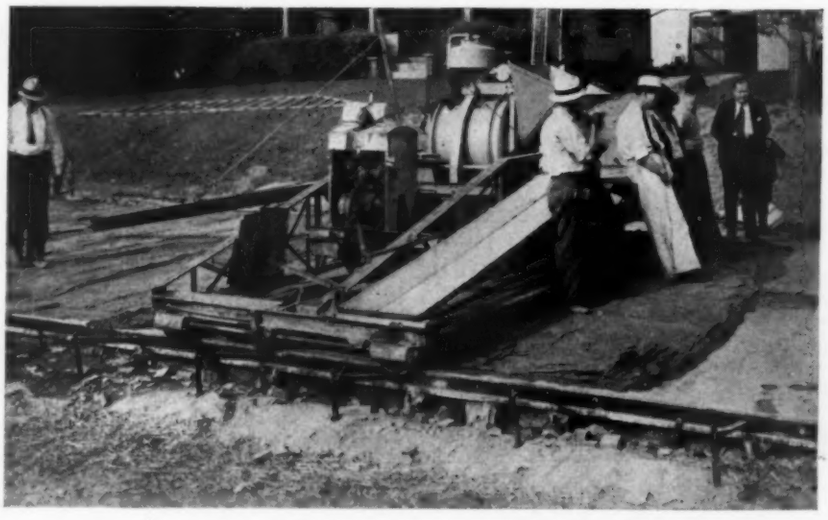
recommended practice, but the boys must "get the dope."

• •

¶ I hope Oklahoma and Texas bought some snow plows this year. I'd hate to get snowbound again for two days in that "sunny South."

• •

¶ Speaking about Oklahoma; seems like what the well dressed contractor should wear down there is a "shootin' iron." How about it, Mr. Sammons? Sammons is on a dam job on Grand River.



¶ "The Center Line," a monthly bulletin of the Montana State Highway Department just streaked across my desk. In passing I snatched the following items of interest:

An example of erosion: The island of Helgoland in the North Sea contained an area of 120 square miles in the year 800. In 1300 the waves had reduced it to 45 square miles, in 1649 to 4 square miles, and today there is left only one-third of a square mile of surface.

In his younger days he [talking about Ray Spurzen, Project Engineer—A. P. J.] had a "yen" for traffic directing when the occasion demanded. Favorite expression: "Damn it, 8 o'clock Monday morning, tomorrow's Tuesday, next day Wednesday. Half the week gone and nothing done yet. Hurry up and let's go!"

[Apparently he lives up to his monicker.—A. P. J.]

FRAGILE FEMME FOREVER FICKLE

Eve Kraft came to work with a bandaged hand. She says she bruised it at home. Yesterday she was seen bicycling, the latest craze, down the sidewalk. While rolling along she spied a man and a lamppost at the same time———. WELL! ———! her story may ? be true. [Please pardon the rearrangement. —A. P. J.]

OVERHEARD IN THE OFFICE

By Beverly Burke

Comes a time in the life of every amanuensis when the sometimes irksome duties are mitigated by a letter's passage or by a visitor's utterance, the result of which causes us to chuckle inwardly. Some are slips of the tongue, no doubt, but we have recorded all remarks and sentences heard and seen within the past few weeks ere they elude our torpid memory, and now lest these gems be lost to posterity forever we pass them on:

"June 30th is the end of the Highway's physical year."

"He spoke slowly, allowing an interview of about three minutes between sentences."

"When the cases are so similar, which one takes procedure?"

"I was surprised at that couple getting a divorce. I never heard of them having had martial trouble."

"He came in right at the crucible moment."

"He put the medicine in a giblet of water."

"Is liquor really an anecdote for snake bite?"

"It may be true our signs are cracked, but we are sure they did not peal." (This from a letter.)

"He is issuing orders under false premises."

Next to bowlegs, a girl's worst handicap is a sense of responsibility.

A STENO'S LAMENT

Employers, I have heard, get fresh.
They proposition you.
They take you out to dinner
When the office day is through.
They shower you with presents
Give you bonuses galore—
They hint that if you're nice to them
They'll give you even more.
You've got to humor them, or else
You'll find that you've been fired—
I work from nine to five, and all
I ever get is tired.

On a sheet of paper place nine dots like this:

. . .
. . .
. . .

Then draw lines through all of the dots without lifting your pencil from the paper, *making only four straight lines.*

• •

¶ This is in the Rio Grade canyon in New Mexico. I took these pictures to show how the WPA have

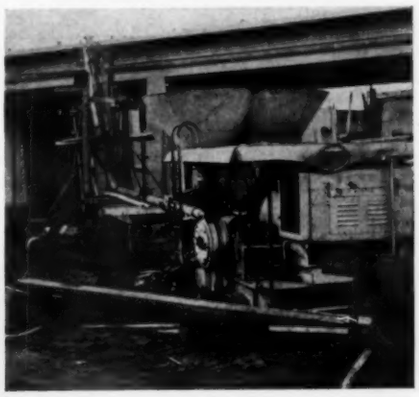
gone into the use of heavy equipment for road building. First the

air drill pokes a hole for the blast; then the shovel and trucks remove

what they can; finally the large rock are rolled over the side of the road fill into the river with a bulldozer. The WPA are widening that abominable road just beyond the entrance to the canyon northwest of Santa Fe. A few miles farther the state highway department is doing a heavy grading job with state owned equipment. A casual visitor could guess that. However, anything in the way of improvement is highly desirable. The road provides a tortuous experience in driving.

• •

¶ In building a grade separation at Lynbrook, Long Island, Poirier and McLane, contractors, loaded this Pumpcrete from a Blaw-Knox concrete bucket with a Lima crane. It



was certainly an easy way to pour the deck slab. A Worthington air compressor provided power for vibrating the concrete in place.

• •

¶ I noted some signs in Ohio, also in Texas, that I think represent a good idea. On U. S. 20, in Ohio, there are some which state, "Beginning HT 125," "End HT 125." It explains the type of surfacing. The general public is interested in surface types. This provides them something to talk about. The signs in Texas were along the right of way fence south of San Antonio. I went by too fast to be able to read them.

• •

¶ Naming no names, we observe that certain southern states are still backward in matters of education, and that considerable portions of the bovine population have not yet learned the advantage of keeping off main highways. Very mildly we suggest that where education fails, restraint would be in order in the interest of safety to all concerned.

• •

¶ If you haven't done so, try precoating your aggregate for winter maintenance. We hear that it helps considerably.

INTERESTING AUTOMOTIVE DATE

1887—Ransom E. Olds built a 3-wheel steam-driven car.

American Road

WASHINGTON, D. C.

GEORGIA "HIGHWAY JAMBOREE"

Down the Road

By CHARLES M. UPHAM

Engineer-Director, American Road Builders' Association, Washington, D. C.

CITIES DEPEND ON HIGHWAYS FOR FOOD

A big city eats like a giant. It really would take a beanstalk in Central Park the size of that planted by Jack to supply that particular vegetable in sufficient quantities to feed the teaming millions of New York City. Not only New York, but Chicago, Washington, San Francisco, Philadelphia, New Orleans, Fort Worth and all the other great metropolitan centers of this country are dependent upon a gigantic day-by-day supply of food that is transported by trucks over the highways from the outlying districts to the city markets. Of course, the situation is somewhat different in smaller towns where the inhabitants are much closer to the gardens, orchards, farms and dairies that provide the good and wholesome things to eat for their respective dining tables. But, even the small town grocery stores and butcher shops depend to a large extent on the delivery of produce by truck.

In Volume 22, No. 4, of "The Agricultural Situation," issued by the Bureau of Agricultural Economics of the U. S. Department of Agriculture, William C. Crow says, "Large city markets now receive about half their supply of fresh fruits and vegetables by motor truck. A survey in 1936 revealed that nearly 45 per cent of the supply of 40 large cities was transported by motor—New York City, about 40 per cent; Philadelphia, 45; Boston, 33⅓. The figures ranged up to 72 per cent for Atlanta and 83 for Los Angeles."

Mr. Crow further states, "The use of the motor truck in moving produce from grower to consumer has resulted in many economies. The produce is picked up at the farm and moved directly to the market. Frequently delivery is made direct to retail stores. The number of handlings is reduced. Costs of transportation are often less than short-haul or less-than-carload of rail rates. Speedier delivery reduces losses from spoilage."

But don't lose sight of the important part played by the highway! While the big cities depend on truck delivery for their fruits and vegetables, the truck drivers must be able to depend on the road! If the highway is not a good one and safe to travel at a rate that will guarantee the speedy delivery referred to in Mr. Crow's statement, the ability of the vehicle itself and the skill of the driver will mean very little in achieving the desired goal.

I am going to make use of only a few figures to give you a further conception of the extent of motor truck use in the transportation of perishable goods and other commodities. There are 4,241,000 trucks in operation today on the highways of this country and more than 3,100,000 drivers are employed to operate them.

Take the delivery of milk, for example, which is so important to the children of any community. Statistics show that 21 leading cities receive nearly all of their milk supply by motor truck, which means that the milk must be hauled each day over the highways from the outlying countryside to the city outlets. Such metropolitan centers as Cincinnati, Los Angeles, Detroit, Spokane and Minneapolis receive 100 per cent of their daily milk supply via the highways.

Who, therefore, can contest the statement that a system of good and safe highways is a vital and absolutely necessary adjunct to the business of keeping the inhabitants of our cities and towns well fed.

GEORGIA "HIGHWAY JAMBOREE" PROCLAIMED A HUGE SUCCESS

As Reported by George R. Dempster, Engineer-Manager Tennessee Road Builders' Association

On September 29, Paul L. Andrews, dynamic secretary of the Georgia Highway Contractors' Association, led a horde of 400 road builders to beautiful Lithia Springs, 18 miles out in the country from Atlanta near Austelle, Ga., where a large and successful "highway jamboree" and good roads meeting was enjoyed by all. To the festivities came one, Charles M. Upham, America's premier road builder, accompanied by his right-hand man, William "Friday" Slee, and Secretary A. E. O'Brien of the Associated Pennsylvania Constructors. Despite the fact that these gentlemen hail from the other side of the "hot-bread line," sometimes called the Mason and Dixon line, they were not, however, met at the city gates with shotguns and muskets and accorded the same reception that was extended to General Sherman in the late '60s. Instead, they were greeted with open arms by the South's leading highway contractors and they were given a welcome that only Georgia "crackers" know how to extend.

Many of said contractors, having spent the early part of their lives hopping clods and chopping cotton, used the same old "down on the farm stroke" while trying to knock little white balls around the golf course. Some of them should have been credited on a yardage basis for the earth they moved or on a square foot basis for the sod they destroyed. Under the rules of the game, however, each stroke was charged against the respective stroker. Charles M. Upham shot about 140 for the 18 holes, but took refuge behind the fact that, having sojourned for some time in Mexico, his strokes, therefore, had only a Mexican value; that is, 50 per cent American. He should, therefore, have been charged with only 70 strokes. The rules committee took the matter into consideration and will announce its decision in March, 1939, at the next AR.B.A. convention in San Francisco.

Bill Slee got in the rough and the game was called on account of darkness before the made the round. His score, therefore, was not entered in the official records. A. E. O'Brien of Pennsylvania was seriously considered for the booby prize until he got in the feed line. After running through three times, they gave him credit for his prowess by reducing the number of strokes charged to him by 15, leaving a net of 150. For the information of

Builders' Review

NOVEMBER, 1938

Motor vehicles consumed eight per cent more lubricating oil last year than all other industries combined.

PROCLAIMED A HUGE SUCCESS

A. R. B. A. COMMITTEE APPROVES 1939 EXHIBIT MODEL

The Joint Exhibit Committee of the American Road Builders' Association met in Engineer-Director Charles M. Upham's offices in Washington, D. C., on October 17 to make plans for the 36th annual Convention and Highway Exhibit of the association to be held in San Francisco, Cal., next March 7-10. They approved the model shown above as the general decorative theme for the San Francisco Civic Auditorium, where the highway exhibit will be staged. The treatment of booth space in the model will be followed by the individual exhibitors in staging their displays. Mr. Upham was placed in full charge of arrangements for the reproduction of the model in the San Francisco auditorium. The model was designed and produced by the A.R.B.A. Public Relations Department.

Members of the A.R.B.A. Joint Exhibit Committee shown grouped around the model in the picture are: left to right, standing, Henry M. Schramm, president, Schramm, Inc., West Chester, Pa.; William P. McDonald, president, William P. McDonald Construction Co., Flushing, N. Y.; Mr. Upham; A.R.B.A. President Murray D. Van Wagoner and Michigan state highway commissioner; William M. Parrish, president of the A.R.B.A. Manufacturers' Division and industrial sales executive, International Harvester Co. of America, Chicago, Ill.; Paul C. Griffiths, vice-president, Koppers Products Co., Pittsburgh, Pa., and George F. Schlesinger, chief engineer and managing director, National Paving Brick Association, Washington, D. C. Seated, left to right, are C. D. Macpherson, Gar Wood Industries, Inc., Detroit, Mich.; Carl W. Brown, chief engineer, Missouri State Highway Department, Jefferson City, Mo., and Lion Gardiner, vice-president, Jaeger Machine Co., Columbus, Ohio.

Other members of the committee, not pictured above due to inability to attend the meeting, are: Otto S. Hess, engineer-manager, Kent County Road Commission, Grand Rapids, Mich.; Chauncey B. Smythe, Thew Shovel Co., Lorain, Ohio, and Sam F. Beatty, president, Austin-Western Road Machinery Co., Aurora, Ill.

▼

(Continued from page 36)

those not acquainted with Mr. O'Brien, he weighs 250 pounds on the hoof. Not counting the two extra trips made through the bread line by Mr. O'Brien, 358 other happy people took an armful of groceries away from the serving table while participating in the finest barbecue it has ever been my pleasure to attend.

The horse-shoe pitching was hurriedly called off when a cocked-eyed shot by Bill Slee came near killing the cook and the game ended in a draw. To Paul L. Andrews and his aggressive bunch of contractors, many thanks for a most enjoyable outing and I sincerely hope that I will receive an invitation to attend all future functions sponsored by the South's strongest aggregation, the Georgia "crackers."

▼

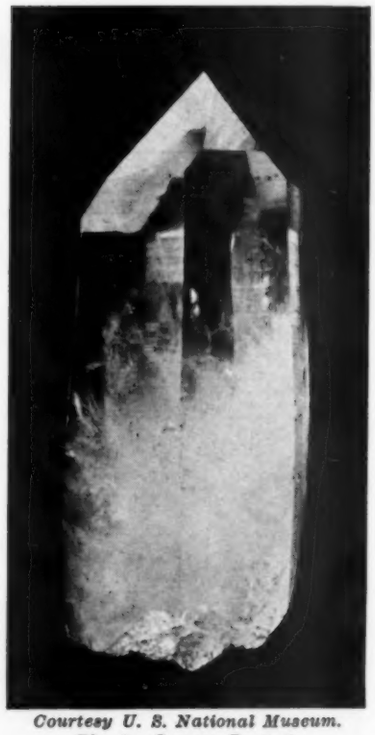
ILLINOIS ROAD BUILDERS PLAN ALL-DAY MEET AND YEARBOOK

The Illinois Road Builders' Association will stage an all-day meeting on Wednesday, November 30, 1938. It will comprise a business session and a series of group meetings that will deal with the various phases of road building. Arrangements have been made for a noonday luncheon and the meeting will culminate in a dinner in the evening. In conjunction with this all-day road meeting, according to an announcement by Ralph W. Ibenfeldt, executive secretary of the I.R.B.A., the Illinois group plans to issue a yearbook and directory containing a list of the membership of the Illinois Road Builders' Association, a list of the congressional delegates from Illinois and a roster of the 61st general assembly which will meet in January. Chief topic on the program will be diversion and ways and means to defeat its spread.

THE COMMON ROCK-MAKING MINERALS

A Chapter from Mr. Runner's Forthcoming Book "Highway Engineering Geology"; to Be Published by the Gillette Publishing Co., 330 South Wells St., Chicago, Ill.

By D. G. RUNNER
Assistant Materials Engineer, United States Bureau of Public Roads.



Courtesy U. S. National Museum.
Fig. 1—Quartz Crystal

THE common rock-making minerals are of fundamental importance to the engineering profession. Irrespective of whether construction work is on the surface or underground, the engineer is constantly encountering problems involving a knowledge of the science of minerology. In soil technology, an understanding of the rock minerals and their decomposition products is dependent upon a knowledge of the hardness, structure, and other associated characteristics of the minerals. In building construction, a knowledge of the more durable minerals and rocks is of assistance in selecting the proper stone, and rejecting the material containing minerals of known softness and non-durability.

Ninety-odd chemical elements are now generally recognized. These elements differ widely with respect to their atomic weight, frequency of habit, and association with one another. Some of these elements, such as silver, iron, aluminum, are common and familiar to most everyone. On the other hand, elements such as tantalum and xenom are very rare. Most of the elements are found in nature, chiefly in combination with one another. The compounds thus formed make up definite mineral species, which now amount to more than 1,500.

These mineral species form the different rock masses, sand and gravel, seen on every hand. When it is realized that 93 per cent of the upper 10 miles of the earth's crust is solid matter (rock, etc.) it is more apparent why rocks seem to be plentiful during certain types of excavating. Some rocks, like the limestone, consist essentially of one mineral, while others contain combinations of various minerals. For instance, the granites (ingneous rock) are usually composed of about eight minerals which are present in varying amounts.

Inasmuch as minerals are so prevalent, it is of considerable value to know something of their character, physical properties, etc., in order to appreciate the role they play in engineering problems. In highway, tunnel, bridge, dam or reservoir construction, direct contact is made with material more or less connected with minerals. Because of this feature, it is believed that the engineer will have a greater appreciation of differences in hardness, type of fracture, durability, etc., of the rock with which he works, if he has an insight into the variable features of the rock-making minerals. The following paragraphs take up the more important phases of descriptive minerology as applied only to the more common minerals. For a more extended treatise on minerals, the references given at the end of this paper should be consulted.

Definition of Mineral—A mineral is defined as a substance found in nature, having a characteristic chemical composition and usually a definite crystalline structure.

Hardness—The hardness of minerals is used to more or less classify them into the various groups as an aid to identification. Sometimes the ability to classify a mineral by its hardness is of considerable value in the field. This feature, together with other physical properties such as color, streak, crystal-structure, etc., help to identify the mineral at hand. The hardness, or resistance to abrasion, is determined by comparing the unknown mineral with the following table known as the "hardness scale":

HARDNESS SCALE

1. Talc	6. Orthoclase
2. Gypsum	7. Quartz
3. Calcite	8. Topaz
4. Fluorite	9. Corundum
5. Apatite	10. Diamond

In using this scale, if the unknown mineral will scratch apatite, its hardness is greater than 5. If, however, the unknown mineral is scratched by orthoclase, the hardness in question must be less than 6, or about 5½.

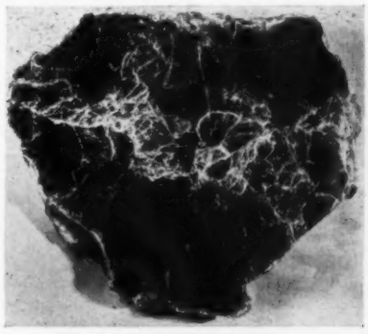
In lieu of the hardness minerals, the following articles may be used to determine approximately the hardness of unknown minerals. The fingernail is about 2 in the scale of hardness; a penny is about 3; a penknife

blade about 5½; window glass nearly 5½; and a steel file about 6½.

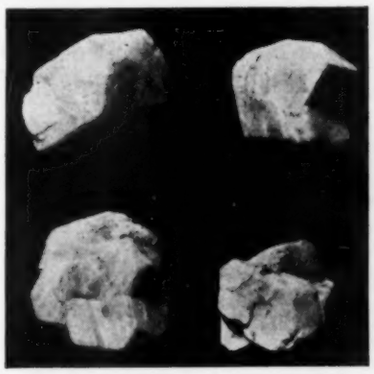
Luster of Minerals—Luster is a property exhibited by minerals, and is a term used to describe that property which is dependent upon the surface and the variation in the amount of light reflected from the surface of the mineral. The two chief kinds of luster are identified as *metallic* and *non-metallic*. As may be deduced from the word metallic, this term refers to that luster characterized by the metals and semi-metals such as gold, copper, iron, silver, chromium, etc. On the other hand, non-metallic luster is found in minerals which are transparent to light on their thin edges. A few of the more common terms used to describe the luster of minerals are:

Vitreous—or the luster exemplified by broken glass. Examples are: quartz, rhodonite, topaz.

Courtesy American Museum of National History.
Fig. 2—Orthoclase Feldspar



Courtesy Ward's Nat. Science Est.
Fig. 3—Muscovite (White Mica)



Courtesy Ward's Nat. Science Est.
Fig. 4—Andesine Feldspar

Greasy—The luster of oily glass. Examples are: sphalerite (zinc blende), nephelite.

Adamantine—the luster of minerals having a high index of refraction, such as the diamond, cinnabar, etc.

Resinous—or the luster of resin. Examples are: opal, witherite.

Pearly—or the luster of pearl. Examples are: talc, brucite, stilbite, etc.

Silky—the luster of a fibrous material. Examples are: gypsum, asbestos.

Dull—Essentially an earthy luster. Examples are: kaolin, chalk.

Specific Gravity of Minerals—The specific gravity of a mineral is one means of classifying an unknown specimen. The mineral which does not vary in its composition has the same specific gravity, and this factor is an important aid in the proper identification. With a little practice one can quite often approximate the specific gravity of a mineral or rock by hefting it in the hand. Obviously those metallic minerals such as iron, gold, etc., can at once be differentiated from the lighter minerals such as opal, quartz, etc. The specific gravities of the more common minerals are given in the table below:

SPECIFIC GRAVITY OF COMMON MINERALS
(Arranged in ascending order)

2.10—Opal	2.67—Chlorite	3.35—Pyroxene
2.20—Sodalite	2.70—Calcite	3.50—Topaz
2.30—Gypsum	2.80—Talc	3.75—Staurolite
2.45—Leucite	2.85—Dolomite	3.80—Garnet
2.55—Nephelite	2.86—Muscovite	4.00—Corundum
2.57—Orthoclase	2.90—Biotite	4.90—Ilmenite
2.60—Serpentine	3.15—Apatite	5.00—Pyrite
2.62—Albite	3.20—Amphibole	5.20—Hematite
2.65—Quartz	3.30—Olivine	5.20—Magnetite

Streak—This refers to the color of the mineral when powdered or to the powder caused by scratching upon a piece of unglazed procelain. Although the color of a mineral may vary somewhat, the streak remains fairly constant, and is a means of partially identifying the specimen in question. However, minerals having a hardness of about 7 or greater, leave no streak on the porcelain because they are harder than the plate. In this case crushing the mineral with a hammer and examining the powder enables one to determine the streak. The following examples show the external color of the mineral and the corresponding streak:

Mineral	*Color*	*Streak*
Calcite	White	White
Galena	Lead-gray	Lead-gray
Ilmenite	Iron black	Black to brownish red
Limonite	Dark brown to black	Yellowish brown
Antimony	Tin-white	Gray
Pyrrhotite	Brownish-bronze	Black

Fracture of Minerals—By fracture is meant the surface obtained by breaking minerals in a direction other than with the cleavage or parting. The following terms are descriptive of the fractures of common minerals:

Conchoidal—fracture like a shell; the fractured faces are curved. Examples are: quartz and olivine.

Hackly—fractured surfaces that are very irregular and rough. Example: copper.

Splintery—the mineral breaks into fibers or splinters. Example: serpentine.

Earthy—an irregular fracture which is characteristic of such earthy substances as kaolin and bauxite.

Uneven—the fractured faces present an uneven or irregular surface. Examples are: barite, galena, marcasite.

Structure of Minerals—The structure refers to the form assumed by the mineral. This may be amorphous (without crystal form) or crystalline. Minerals occur in a great diversity of form, and the following terms are the more common ones used to describe certain types of structure:

Bladed—as the name indicates, a tabular or platy type of structure. Example: kyanite.

Fibrous—refers to the filament-like or slender fibrous masses. Example: wavellite.

Micaceous—refers to thin plates or scales. Example: biotite, or muscovite mica.

Oolitic—small, rounded particles like fish roe. Example: Bedford limestone.

Acicular—slender, delicate needle-like crystals. Example: natrolite.

Botryoidal—spherical masses, like a bunch of grapes. Example: hematite.

Tabular—flat, broad surface. Example: celestite.

Quartz (Fig. 1)

General Properties—Chemical composition is SiO_2, the hardness is 7, the specific gravity 2.65. The structure is usually crystalline, or massive, with a vitreous to greasy luster. The color ranges from white through pink, yellow, to black. The streak is colorless, and the fracture is conchoidal.

Occurrence—Quartz is found widely distributed, especially in sandstone formations and certain of the igneous rocks, such as the granites and the rhyolites. Because of its great resistance to acids it is very durable and consequently is the chief constituent of sands and gravels. Chert, flint, jasper, and chalcedony are usually regarded as the crypto-crystalline (exceedingly fine-grained) varieties. In addition there are such types of quartz-bearing rock as quartzite, granular quartz, quartzose sandstone, burhstone, quartz conglomerate, etc.

Orthoclase Feldspar (Fig. 2)

General Properties—The chemical composition is $KAlSi_3O_8$, the hardness ranges from 6 to 6½, and the specific gravity is about 2.57. The structures are usually massive, and the mineral has a decided vitreous luster. The color ranges from white through yellow, red to gray. The streak is colorless, and the fracture is uneven to conchoidal.

Occurrence—Orthoclase, like quartz, is of widespread distribution. It was formed during the crystallization of igneous rock. In addition to these igneous rocks such as the granites, it is found in certain sedimentary rock (graywacke, arkose sandstone, etc.), and in some types of metamorphic rock. Due to the action of various agencies, such as acid-charged waters, the orthoclase feldspar may be altered to kaolin (clay) or to muscovite mica. The change in composition may be expressed as follows:

$$2KAlSi_3O_8 + 2H_2O + CO_2 - H_4Al_2Si_2O_9 + 4SiO_2 \times K_2CO_3$$

Orthoclase together with quartz form the pegmatitic rocks found in certain areas of the United States.

Biotite, or Black Mica

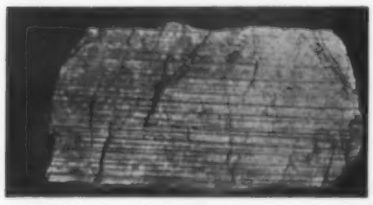
General Properties—The chemical composition of biotite is varied and complex. It consists chiefly of hydrous potassium, magnesium, iron, and aluminum silicate. It has perfect cleavage, and is usually smoky to black in color. The hardness is about 2½ and the specific gravity ranges from 2.95 to 3.00. This gravity is much greater than would ordinarily be expected of a foliated mineral. Due to the action of weathering agencies, biotite often alters to green chlorite.

Occurrence—Biotite mica is an important rock-making mineral of many different kinds of igneous rocks, and of course is of wide distribution. It is quite often found in veins in large sheets. One of its most common habit is in the granites. It also occurs as the product caused by metamorphic action in gneisses, schists, etc. It cleaves readily into thin, scaly sheets.

Muscovite, or White Mica (Fig. 3)

General Properties—Chemically this mineral is a hydrous potassium-aluminum silicate, having a hardness of 2 to 2½ and a specific gravity of 2.76 to 3.00. The color is white, yellowish through gray to brown. The luster on the cleavage face is pearly to vitreous. The structure is shown in figure 3.

Occurrence—Muscovite is a very stable mineral as evidenced by the fact that it is found in abundance in sands. The mineral is found is granites, syenites, pegmatite veins, and is especially common in gneisses and schists. Muscovite readily cleaves into thin transparent leaves and may easily be identified by its glistening appearance. It sometimes is found in large sheets or plates, known commercially as "isinglass." Quite often muscovite is of secondary origin, being derived from the alteration of other minerals such as feldspar, topaz, kyanite, etc.



Courtesy Ward's Nat. Science Est.
Fig. 5—Striated Oligoclase Feldspar

Courtesy American Museum of Natural History.
Fig. 6—Hornblende (Amphibole)

Courtesy American Museum of Natural History.
Fig. 7—Dolomite

Andesine Feldspar (Fig. 4)

General Properties—Chemically, andesine belongs to the lime-soda plagioclase feldspar. Its hardness lies between 5 and 6, and the specific gravity ranges from 2.60 to 2.75. The color varies from white, gray, through yellow to flesh-red, and the crystalline form (Fig. 4) has a vitreous to pearly luster.

Occurrence—Andesine is found in many basic volcanic and granular rocks such as syenites, etc., and it constitutes almost the entire percentage of the rock known as andesite. It is characteristic of rocks having a "medium" silica content. (See Table I.)

Oligoclase Feldspar (Fig. 5)

General Properties—Chemically this material is a soda-lime feldspar, containing a predominant amount of soda. As in the case of most feldspars, the hardness is about 5½. The specific gravity is 2.60 to 2.75, the luster is vitreous, and the streak is colorless. A view of oligoclase, showing the striated character, is shown in Fig. 5.

Occurrence—One of the intermediate plagioclase feldspars (see Table I for percentage composition). Oligoclase is one of the more common rock-making minerals and is found in the more acid types of rock such as syenites, diorites, granites, gneisses, etc. Sometimes found associated with orthoclase in certain granitic rocks. Sometimes found in andesites and trachytes. (See Table I.)

Hornblender (Fig. 6)

General Properties—This mineral belongs to the general group of amphiboles, and is essentially a calcium-magnesium silicate with occasionally some sodium, aluminum and magnesium added. Its hardness is about

the same as feldspar (5 to 6). The specific gravity is about 3.00, with a decided vitreous luster. The structure of the mineral is commonly prismatic, see Figure 6, with a color ranging from dark green to black. The fracture is subconchoidal to uneven.

Occurrence—Hornblende is among the more recurring rock-making minerals, and is to be found in both igneous and metamorphic rocks, with probably the greater abundance in the latter type. Hornblende schists, and hornblende granites are among the common rock types, and are to be found in many parts of the world. The basaltic type of hornblende is found only in the basic igneous rock such as the gabbros, basalts, etc. Rocks which carry an abundance of hornblende are called "hornblendites."

Dolomite (Fig. 7)

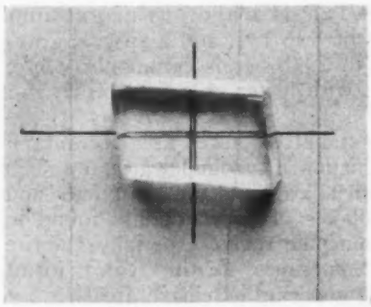
General Properties—Dolomite, the mineral, is a double carbonate of calcium and magnesium. It has a hardness between 3 and 4, a specific gravity of about 2.80 to 2.90. The color is usually white, with a vitreous luster and a colorless streak. The fracture is subconchoidal. The rock known as dolomite is essentially a limestone consisting dominantly of the mineral dolomite. It is considerably harder than a true limestone, and will not effervesce freely with acid as in the case of limestone.

Occurrence—Dolomite is found chiefly in the sedimentary strata of world wide distribution, and is especially abundant in the older "sediments." It is sometimes found as an accessory mineral in certain crystalline schists. Dolomite is also a vein mineral commonly found with metallic ores. The crystalline type is sometimes associated with serpentine and other magnesian minerals.

Calcite (Fig. 8)

General Properties—This mineral is a calcium carbonate ($CaCO_3$), having a hardness of 3, and a specific gravity around 2.71. The luster is usually vitreous, and the color ranges from white through gray, yellow, blue, red to black. The structure may be crystalline or granular. Sometimes it is fine-grained and compact. The fracture is usually conchoidal.

Occurrence—Calcite, like quartz, is a very common and widely distributed mineral. It is a minor constituent of secondary origin of the igneous rocks, caused by the action of carbonated water on the calcium silicate minerals. It forms enormous deposits of rock known as limestone, marble, chalk, marl, etc. It is quite often found as the cementing medium in certain sandstones. In the economic field, it is found as a gangue material with certain metallic ores. It is deposited as travertine in connection with hot springs, and is also found in caves as stalactites and stalagmites.

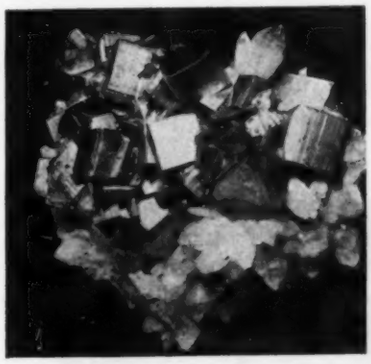


Courtesy Ward's Nat. Science Est.
Fig. 8—Calcite, Showing Double Refraction

Pyrite (Fig. 9)

General Properties—This brass yellow mineral of the composition FeS_2 has a hardness of 6 to 6½, a specific gravity of around 5.0, and a decided metallic luster. The mineral usually occurs in crystalline form (the cube) and oftentimes certain of the crystal faces show striae, which is a characteristic feature. The fracture is conchoidal to uneven.

Occurrence—Pyrite is quite common in rocks of all ages, especially so in the metamorphic and igneous groups. The greatest concentration of course, is to be found near contact zones of igneous intrusions. It is also found at times in coal strata. In addition it occurs as a minor constituent of igneous rocks, and as a gangue mineral in veins. Pyrite readily alters by oxidation to the iron sulphate or to the hydrated oxide (limonite).



Courtesy Ward's Nat. Science Est.
Fig. 9—Pyrite

Marcasite (Fig. 10)

General Properties—Marcasite, or white iron pyrites, has the same chemical composition as pyrite. The hardness is about the same as for pyrite but the specific gravity in general is found to be between 4.80 and 4.90. It has a metallic to dull luster, yellowish to white in color, and is usually found in the massive, globular or fibrous form. The streak is grayish to brownish black and the fracture is uneven. The mineral alters very readily to limonite.

Courtesy Ward's Nat. Science Est.
Fig. 10—Marcasite

Occurrence—Marcasite is quite often found as a replacement deposit in limestone beds and as concretions in marls and clays. Commonly associated with calcite, fluorite and especially with galena in the chert area of Missouri. It is sometimes associated with the lignites. It alters more readily than pyrite.

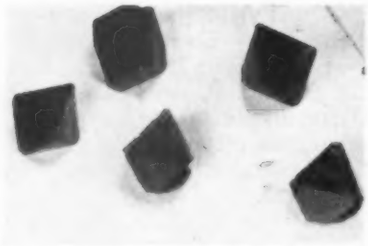
Magnetite (Fig. 11)

General Properties—Magnetite, or magnetic iron ore (lodestone) is the oxide of iron Fe_3O_4. It is strongly magnetic, with a hardness of 5½ to 6½. The specific gravity is about 5.20, and the streak is black. It occurs usually in the crystalline form, with a metallic luster and an uneven fracture. It sometimes alters to the mineral limonite.

Occurrence—Magnetite is one of the widely distributed rock-making minerals found in all types of igneous rocks mainly basic, and in certain metamorphic rocks such as the crystalline schists. It is a common alteration product of certain minerals containing iron oxide. Commonly found in beach sands, and as an important ore of iron.

Corundum (Fig. 12)

General Properties—Corundum, the aluminum ox-



Courtesy Ward's Nat. Science Est.
Fig. 11—Magnetite

ide Al_2O_3, is ninth in the scale of hardness, has a specific gravity of 4.00, and has a dull to vitreous luster. It is usually granular to crystalline, and is dark gray to blue gray in color. It has a colorless streak and does not alter readily. The fracture is uneven to conchoidal.

Occurrence—Corundum is one of the hardest rock-forming minerals. It is a primary mineral in igneous, and is fairly common in metamorphic rocks. It is sometimes associated with the micas, magnetite, spinel, etc. Found disseminated in crystalline limestone. Used as an abrasive material.

Garnet (Fig. 13)

General Properties—Garents are complex silicates containing iron, magnesium, calcium, chromium and manganese as the chief elements producing the color so often identified with these minerals. The hardness varies from 6½ to 7½, and the specific gravity from 3.50 to 4.20. The luster is glassy to resinous and a colorless streak is usually found. The color varies from white through pink, brown to black, depending upon the chemical elements present. The fracture is subconchoidal to uneven.

Courtesy American Museum of Natural History.
Fig. 13—Garnet

Occurrence—Garnets are commonly distributed through the igneous and metamorphic rocks. They occur in small amounts as to be classed as accessory rather than primary minerals. It is especially noted that garnets are to be found in the crystalline schists which have been subjected to insense metamorphism. The mode of occurrence is largely dependent on the chemical composition, the lime variety being characteristic of the calcerous rocks, the magnesium variety of basic igneous rocks, etc.

Serpentine (Fig. 14)

General Properties—Serpentine is a hydrous magnesium silicate having the general formula of $H_4Mg_3Si_2O_9$. It has a hardness of 2½ to 3, a specific gravity of 2.20 to 2.70. The color varies from green through black, brown to white. The luster is greasy or dull. In structure, the mineral is usually fibrous (see Fig. 14), massive or granular. The fracture is sometimes conchoidal, sometimes splintery.

Courtesy Ward's Nat. Science Est.
Fig. 14—Serpentine, Variety Chrysotile

Courtesy Ward's Nat. Science Est.
Fig. 12—Corundum

Occurrence—Serpentine is usually considered as a secondary mineral caused by the alteration of the magnesium silicates. It is found in both igneous and metamorphic rocks. In the latter type of rock, it occurs as layers, or lens-shaped bodies. Commonly associated with garnet, chromite, spinel, etc.

Talc

General Properties—Talc is a hydrous magnesium silicate with a hardness of 1 to 1½, and a specific gravity ranging from 2.70 to 2.80. It is commonly white, green, or gray in color, with luster greasy to pearly. pearly.

Occurrence—Talc is usually classed as a secondary mineral formed by the action of ground waters on such magnesium silicates as the pyroxenes and the amphiboles. It is commonly found in the metamorphic rocks, especially chlorite schists. Sometimes steatite (talc) forms large beds covering extensive areas.

TABLE 1—PLAGIOCLASE FELDSPARS, SHOWING THE APPROXIMATE PERCENTAGE OF SODA AND LIME IN EACH VARIETY, FOR THE SAKE OF BREVITY ABBREVIATED TO AB—AN GROUP.

Name		Soda, %	Lime, %
Albite	(Ab)	100 to 90	0 to 10
Oligoclase	↑	90 to 70	10 to 30
Andesine	↕	70 to 50	30 to 50
Labradorite	↕	50 to 30	50 to 70
Bytownite	↓	30 to 10	70 to 90
Anorthite	(An)	10 to 0	90 to 100

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A BRIEF REVIEW OF THE 1938 BITUMINOUS CONFERENCE

THE Montana National Bituminous Conference again demonstrated its up-and-coming character in the meeting at Edgewater Park, Mississippi, October 10 to 13—far indeed from its ancestral home.

Technical sessions, entertainment, fellowship, and inspection tours of Mississippi highways and highway construction gave members guests about all that they could ask. Credit goes to the Montana and Mississippi State Highway Departments, the Western Petroleum Refiners Association, and the following cooperating companies:

Allied Material Corp., Anderson Prichard Oil Corp., Ashland Oil & Refining Co., The Kanotex Refining Co., Lion Oil Refining Co., Macmillan Petroleum Corp., Mid-Continent Petroleum Corp., The Ohio Oil Co., Pan-American Petroleum Corp., Shell Petroleum Corp., Skelly Oil Co., Socony-Vacuum Oil Co., White Eagle Division, Standard Oil Co. (Indiana), Standard Oil Co. of Louisiana, Talco Asphalt and Refining Co., Union Asphalts & Road Oils, Inc. The hospitality event between Montana last year and Mississippi this year was declared a draw by the referee.

As an account of a meeting of this sort is apt to be about as interesting to one who wasn't there as a description of a good dinner to one who didn't eat it, I shall make this story short, leaving details to imagination.

Proceedings of the Conference, to be published in the near future, will contain the papers presented and also the discussion. Five main sessions were held—one devoted to each of the following subjects:

PROGRESS IN RESEARCH AS RELATED TO CONSTRUCTION AND MAINTENANCE OF BITUMINOUS SURFACES
N. W. McLeod, Regina, Saskatchewan, Chairman.

FUNDAMENTALS OF BITUMINOUS CONSTRUCTION
T. E. Stanton, Sacramento, Calif., Chairman.

CONSTRUCTION OF BITUMINOUS SURFACES
V. B. Steinbaugh, Lansing, Mich., Chairman.

MAINTENANCE OF BITUMINOUS SURFACES
A. B. Nuss, Topeka, Kansas, Chairman.

ROUND TABLE DISCUSSION—QUESTIONS AND ANSWERS
(This interesting and profitable session was substituted for the originally scheduled sight-seeing trip to New Orleans and vicinity, for which little enthusiasm developed.)

An excellent departure was made this year in the preparation of papers. Under a definite plan among the authors and the section chairmen, about a dozen papers were written on each principal subject, then condensed and combined by the chairman and assistants into the form presented at the conference. The resulting thoroughness, coherence, elimination of repetition, and general simplification increased the value of the material, saved time, and improved the quality of the discussions.

One criticism, however, must be made: the discussions were dominated too much by the technologists. In the session on research this was proper and to be expected, but in the other sessions it was unfortunate in spite of valuable facts and opinions brought out. Let me hasten to add that the fault lay less with the laboratory and research men than with their brothers from the construction and maintenance fields, who neglected opportunities to raise questions and bring out points. It should be possible to get more extensive discussions of construction and maintenance problems by planning in advance for starting and carrying them on. If done skillfully, this would involve only a little "cut and dried talk" and no increase whatever in limitations on speakers.

The registered attendance of 464 members and guests was in excess of the 1937 meeting, in addition to which about 60 were registered at the hotel, but for one reason or another not at the conference. The Edgewater-Gulf, opened especially for the occasion, supplied material needs in excellent fashion.

Abundance, quality and variety of entertainment left us all happy, but I shall burden you with no more except to recommend that if you never saw a battle royal or a can fight, you visit the far South under proper auspices.

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GAS TAX DIVERSION DOES NOT SUPPLY JOBS

This is the kind of effort needed to be exerted by everyone who has any connection with the highway field. The following editorial appeared in the Oct. 17, 1938, issue of the *Chicago Herald and Examiner*:

PROVIDE JOBS

Of Chicago's share of the gasoline tax fund, less than one-half is available for the purposes originally intended —the building of hard roads.

The balance will go toward paying Chicago's share of principal and interest on the $30,000,000 state bond issue for relief—and for the public schools.

Governor Horner has pledged state support for the proposed opening and widening of Congress St. Gasoline tax funds allotted to Chicago, however, will not go far toward the building of the "grand axis" unless liberally supplemented by state funds.

When the gasoline tax was proposed, motorists were assured that every cent of it would be used for highways. But when our economic crisis arose, this fund was diverted to meet the emergency of relief.

Had it been applied to road building, it would have provided work at union wages for thousands of men and would have kept many workers off the relief rolls.

Commitments, of course, will have to be met, but further diversions of this fund will be an unwarranted betrayal of the motorists.

The dole only encourages idleness and makes for pauperization.

Road building supplies jobs.

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CIVIL SERVICE EXAMINATION FOR JUNIOR ENGINEER—The U. S. Civil Service Commission, Washington, D. C., has announced open competitive examination for the position of junior engineer at $2,000 per year in the following lines: Aeronautical, Agricultural, Architectural, Ceramics, Civil, Electrical, Mechanical, Naval Architecture, Structural Steel and Concrete. The duties are:

Under immediate supervision, to perform such professional work as the testing and inspecting of engineering materials, drawing up plans for minor projects, preparing specifications for engineering material or apparatus, performing field work, making computations, preparing maps, assisting in conduct of experimental research, compiling reports, and handling technical correspondence. Applications must be on file with the U. S. Civil Commission, Washington, D. C., not later than Nov. 14, or Nov. 17 if received from the following States: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

BIRMINGHAM MARKS STREET CORNERS

Concrete street markers for the entire city of Birmingham, Ala., are rapidly becoming an actuality as the result of a Works Progress Administration project through which the concrete block markers are being molded and installed at all intersections. Since the

Workman Painting the Concrete Street Markers Prior to Installation.

project began operation last May, the 44 men employed on this work have been turning out an average of 115 concrete block markers a day.

The rectangular blocks have a 3-in. base and four beveled faces to take the inscriptions of the streets. Each marker carries on the longitudinal faces the name of the main street or avenue to which the block is set parallel, with the inscription of the intersecting street on the two end faces. The name of the main street or avenue thus runs parallel to the direction of the street. The shorter faces of the rectangular block carry the intersecting street name or number. This permits, at one glance, observation of the names of both streets at any intersection.

The process used in molding the blocks permits extremely rapid turnout. A dry-mix is used. This is hand-tamped solidly into the mold and sets very rapidly. To make a smooth surface for the street inscription a mix 1 to 2 is used for the faces of the block, while a mix of 1:2:4 is used for the main body.

As soon as the block has set sufficiently and has been removed from the mold, the faces of each are dipped into zinc sulphate so that the lime will not eat or corrode the paint used to make the street inscriptions stand out. Black paint is used in the letter depressions. The paint which was found to be most satisfactory contains bakelite or some rubber base. This insures sufficient body and color to stand out against the white block and also is a better resister of wear and weather.

The project is considered very important and worthwhile by the authorities of Birmingham. The city has never before had any enduring type of street markers. These new concrete signs should insure clear marking at all of the city's intersections for some time to come.

MISSISSIPPI'S IMPROVED GUTTER INLET, OR SPILLWAY BASIN

INLETS for the surface drainage of Mississippi State Highway pavements are not generally located in the pavement itself, but are extended into the shoulder area in a sort of offset, or diversion, of the gutter. Until recently, most of them have been constructed with rather steep side and end curbs, which have been found to involve a traffic hazard to vehicles running too close to the edge of the pavement. There are records of vehicles damaged, upset or deflected erratically from their course when striking them.

To remedy this condition, while at the same time improving the drainage function, the design shown here-

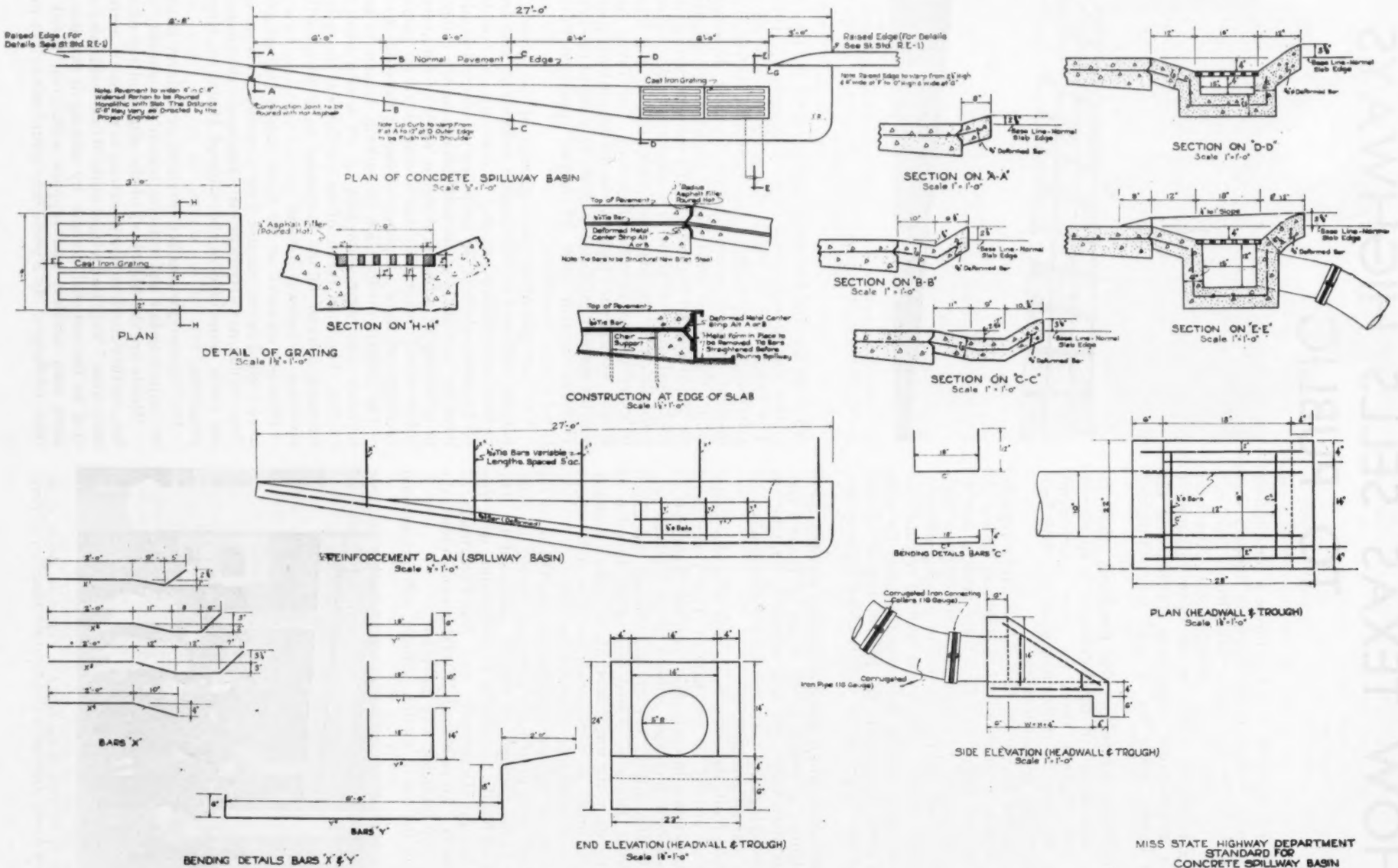
View of a Standard SW-6 Spillway Basin, Looking up Grade. One grating is removed to show interior. Slope of the bottom below gratings is about 1½ in. per ft.

with was developed by E. V. Cavallo, Construction Engineer, and H. S. McElroy, Project Engineer, of the Department. Experience with the new type has been gratifying, and there is no question that the accident menace has been substantially reduced. Complete elimination probably is not possible.

This type of basin is for use where water is to be picked up on slopes or at bridge ends or at other similar locations. At low points to which water flows from both directions, another design is used.

Water is carried away from these basins in 10 in. corrugated pipes, discharging usually at the foot of the bank or into a water course, in a manner to avoid bank wash or erosion. The discharge end of the pipe is supported by a small concrete headwall with extended trough, as shown in the details.

Current bidding prices on these spillway basins are $38.00 to $40.00 each, which includes the basin and its cast iron gratings, headwall and trough, and the pipe connections shown in the detail, but not the main run of pipe, from basin to discharge. The latter is commonly bid at $1.00 to $1.35 per linear foot complete in place.



Details of Standard Concrete Spillway Basin, SW-6, Mississippi State Highway Department.

HOW TEXAS SELLS HIGHWAYS TO PUBLIC

THE first move in Texas to throw a constitutional safeguard around taxes levied on highway users was made Oct. 14 when a "Good Roads Day" rally sponsored by The Texas Good Roads Association adopted a resolution calling on the next legislature to submit a constitutional amendment guaranteeing that highway income would not be used for non-highway purposes.

The resolution pointed out that numerous efforts are made at each session of the legislature to appropriate income from highway taxes for other governmental activities that have no connection, whatever, with highway construction or maintenance.

"Taxes levied against the motorist should be regarded as levies measured by his use of the highway system and it is unfair and unjust to collect these taxes unless the proceeds are applied to construction of additional highways and the efficient maintenance of existing mileage," the resolution stated. "Texas will need all revenues collected from motor vehicle and motor fuel taxes for many years to come to complete the present system of state highways and to provide a well rounded highway network."

The resolution, which was unanimously adopted, asked the legislature "to submit to the people of Texas a constitutional amendment that will effectively prohibit the use of special highway taxes for other than highway construction and maintenance."

The good roads day rally was a part of a two weeks' program of activity on the part of The Texas Good Roads Association in connection with the State Fair of Texas to arouse increased interest in the highway program and traffic safety. The day was officially proclaimed by Governor James V. Allred who called attention of Texas citizens to the importance of the State's highway system and urged its widespread, but safe, use. Scores of Texas road enthusiasts attended the rally.

The value of highway construction and the need for traffic safety were graphically portrayed during the State Fair of Texas through an exhibit sponsored by The Texas Good Roads Association in co-operation with The Texas Highway Department and The Department of Public Safety. An estimated 250,000 persons visited the exhibit which attracted wide attention.

Through the use of motion pictures, still pictures and

Thousands of Persons Were Given a Lesson in Safety at the Texas Good Roads Association Exhibit at the State Fair of Texas

A Novel Transparency Box, Featuring Scenes Adjacent to Texas Highways, Was an Interesting Attraction to Texans and Out-of-State Visitors.

other displays the increasing importance of the highway system was brought home to the thousands of visitors. The Department of Public Safety concentrated on the safety angle; safe highway construction and safety device installations were stressed by the highway department while The Texas Good Roads Association emphasized the importance of highways in the cultural, recreational, social and economic fields. Thousands of booklets giving information on the highway system and what it means to every citizen were distributed by The Texas Good Roads Association. Included in the educational matter was the recently published booklet "Looking at the Texas Highway System from All Angles" prepared by the Good Roads Association.

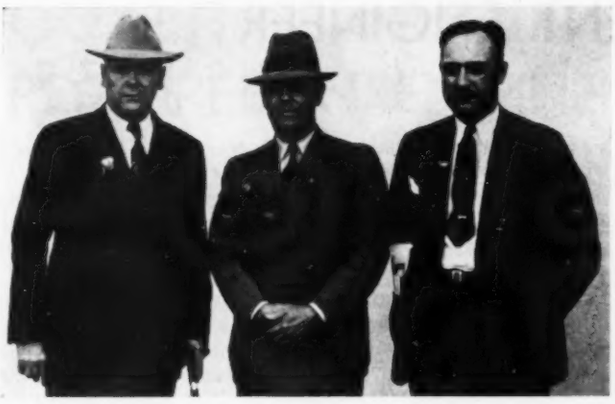
The part played by the highways in the scheme of national defense; in transporting children to and from modern consolidated schools; in fostering and speeding up business relations; in providing widespread employment for thousands of persons throughout the country; in providing an economical means whereby the average citizen could reach the state's marvelous recreational facilities—all were adequately shown in the exhibit.

The dangers of diversion of highway income to non-highway uses were impressed on all who visited the exhibit. The chief theme of the exhibit was directed at fostering interest in the movement to prevent further diversion of highway income.

Principal speakers on the Good Roads Day program were United States Senator Tom Connally of Texas and Rep. Wilburn Cartwright of Oklahoma, chairman of the roads committee of the national House of Representatives.

Rep. Cartwright attacked diversion of highway income as "unjust, unfair and a double tax on the motorist."

"Roads are the life blood of the state and the nation because they touch so many persons so intimately in their daily lives," Rep. Cartwright said. "Good roads also are vital to the national defense by making it possible to move men, artillery and supplies with great speed in times of danger. As a peace time contribution, they pro-



Speakers at the Texas Good Roads Day Rally: Left to Right, Robert Lee Bobbitt, Chairman of the Texas Highway Commission; Lowry Martin, President of The Texas Good Roads Association, and Datus E. Proper, Executive Vice-President of the Good Roads Group.

mote better understanding between communities of one nation and between nations."

Rep. Cartwright lauded The Texas Good Roads Association for sponsoring the rally and recommended that all states adopt constitutional amendments against diversion of highway revenues.

The need for safeguarding highway income also was emphasized by Senator Connally who stated, "the gasoline tax and motor vehicle imposts are tolerated by the people only because of the theory these taxes are going to build good roads. When we reach the point where these taxes are misused, the people will wipe them off the books."

The need for continued construction of rural roads was pointed out by Senator Connally, who called attention to the thousands of Texas farms that were without adequate highway connections. Increasing attention should be paid, Senator Connally said, to planning and construction of county roads. He expressed the opinion that remarkable economies could be effected and great improvements could be made in county road systems through careful and efficient planning.

Other speakers included R. Emmett Morse, the next speaker of the Texas House of Representatives; Robert Lee Bobbitt, chairman of the Texas Highway Commission; Harry Hines, member of the Texas Highway Commission; Julian Montgomery, state highway engineer; Major E. A. Wood, director of the Texas Planning Board; Lowry Martin, president of The Texas Good Roads Association, and Datus E. Proper, executive vice president of the good roads organization. Oscar Burton, first vice president of The Texas Good Roads Association, was program chairman.

The group also adopted a resolution requesting the legislature to take suitable action to eliminate fraudulent collection of gasoline tax refunds. Gasoline tax refunds in Texas amounted to approximately 13 per cent of the gross collections during the last fiscal year. The resolution stated that a study of the gasoline tax in Texas and other states showed this increase to be disproportionate, leading to the conclusion that a considerable portion of the refunds were based on fraudulent claims. A close study of the gasoline tax law with a view of stopping leaks through emergency legislation in January was recommended, the resolution calling attention to the fact that it was unfair for one segment of the population to pay the tax while another segment used tax free gasoline and to the further fact that fraudulent claims were robbing the construction fund of the highway department of hundreds of thousands of dollars annually.

Attention also was given by the group to the problem of fraudulent motor vehicle registrations, violations of the motor vehicle registration statutes having sprung up in Texas during the past few years. The legislature also was requested to take emergency action on this matter by enacting an airtight law with severe penalties for those who violate the registration statutes.

In another resolution, proposed increases in the gasoline tax were condemned. "We believe that the existing levies are sufficiently high and will produce sufficient income to provide for steady advancement of the highway system if said funds are properly safeguarded, conserved and protected," the resolution stated.

The action of the last Congress in reducing federal aid appropriations for highway construction was severely criticized.

"Highway construction constitutes a most desirable form of public works, because of the permanency and usefulness of the improvements and because 90 per cent of the funds expended are spent in the employment of labor, either directly or in related lines," the resolution stated. "The troubled situation abroad has made it necessary that this nation give increasing thought to the adequacy of its means of defense and the rapid mechanization of the armed forces of the United States cannot obtain the full measure of its effectiveness in time of war unless highways are provided over which men, artillery and supplies can be transported swiftly. The industrial development of Texas and the nation also requires the continued construction and expansion of the highway system. The financial support of road building is the chief means through which the federal government can contribute to the cause of highway safety, making it possible for the states to eliminate existing hazards and construct new roads to safely handle the volume and speed of present-day traffic.

"The federal government also is collecting in taxes levied against the users of the highways amounts far in excess of federal appropriations for highway construction, which is unfair and unjust."

Members of the Texas Congressional delegation were requested to exert every effort to obtain reinstatement of the federal aid appropriations and, in addition, to give serious thought to a move to increase federal aid to at least a point where the federal expenditures for highway construction equalled the amount of taxes collected from the highway user.

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SOUTHWEST ROAD SHOW AND SCHOOL—The 12th annual Southwest Road Show and School will be held Feb. 21-24 at Wichita, Kan. Fred G. Wieland, 225 South Water St., Wichita, is manager. On the same dates as the road show, the 36th Annual Western Tractor and Power Farm Equipment Show will be held at Wichita under the same management as the road show.

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ITALY ALSO HAS ITS TRAFFIC ACCIDENT PROBLEMS—Only 439,994 motor vehicles are registered in Italy, and yet during the first four months of 1938 highway and street accidents caused the death of 621 people and the injury of 621. The figures for the first 4 months of 1937 were 703 killed and 10,755 injured.

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OHIO STATE OFFERS NEW WELDING COURSE—A new curriculum in Ohio State University's college of engineering leading to a degree in welding engineering has been announced. Administration of the curriculum will be under the department of industrial engineering. Entrance requirements are the same as for the other curricula of the college of engineering.

THE INDEPENDENT ENGINEER

By C. J. VELZ, C.E.
Fanwood, N. J.

Having heard the author of this article speak in similar dimensions on this topic before the New Jersey Society of Engineers, we prevailed upon him to prepare this article for publication. Having served as P.W.A. State Engineer for New Jersey, in charge of numerous projects involving many problems and adjustments, he is especially well qualified to evaluate present day engineering practices.—ED.

IN THE endeavor to protect a free economy one important factor demands serious consideration—a factor vital to the engineer, the contractor, the manufacturer and the taxpayer. That factor is competition. It is the purpose of this paper to stimulate evaluation of the positive, the constructive aspects of competition as applied to public work.

An age-old problem, filled with complex ramifications cannot be resolved to simple terms. Nor can fair and effective competition prevail without a belief in its inherent values, sufficiently strong to prompt the patience and effort necessary to obtain it. Few challenge the principle of competitive bidding in public work; the law has frequent references to it and the public has come to take it for granted. However, statutory provision and court decisions are no guarantee for competition; the principles must be lived.

The most strategic group to achieve the active practice of these principles is the engineering profession. The engineer, as umpire between the contractor and manufacturer on one side and the taxpayer on the other, carries a heavy responsibility in laying out the plan, drafting the rules and controlling the execution. These responsibilities are the very foundation of the independent practice of professional engineering.

With the advance of mass production methods more of the responsibility for detailed design of individual products is being absorbed by the manufacturer's research staff with less dependence upon the professional engineer. Such research and intensive specialization affords a rapid technical advance with reliability of product. It should be encouraged. In maintaining the independence between buyer and seller it is the function of the professional engineer to integrate the elements into the workable whole and to insure, by fair and effective competition, that the benefits of the manufacturer's research are passed on to the taxpayer in the maximum return for the least expenditure of funds. The future practice of independent professional engineering will be concerned, therefore, more and more with fair and effective competition. Eliminate competition in public works and you eliminate the independent engineer.

The preparation of plans and specifications for fair and effective competition is no simple task. A few observations from current practice may emphasize the problem.

Some Observations on Current Practices

With the tremendous advancement in technical knowledge and in the art of water and sewage treatment, it would be a very unusual circumstance wherein selection was limited to one make of equipment or one process. How open shall specifications be? Shall the door be wide open to admit all, or so tightly closed as to eliminate all but one? Experience has shown that technical perfection must be balanced with reasonable cost. Somewhere between the extremes lies the desirable specification which gives the engineer equipment and materials satisfactory for the purposes intended and at the same time preserves the valuable influences of fair and effective competition.

The contractor should have sufficient information in the specifications clearly to afford him an open market, and when he solicits quotations from manufacturers he should be reasonably certain that such products will be acceptable. Ambiguity involves risks which result in higher prices, inferior products and controversy.

The manufacturer, when quoting, should know clearly from the specifications that to obtain the order he must sharpen his pencil and that price will be the basis of award. Fairness of opportunity will stimulate bidding, reduce marketing expense, improve production and lower the price.

Controversial items should be decided before bidding and clarified in the specifications rather than left as a risk and uncertainty in bidding.

Size of project permitting, contracts for major equipment should be *direct with the manufacturer,* to insure maximum responsibility and minimum cost.

Two common methods of specifying equipment are by detailed description sufficiently broad to include features common to recognized manufacturers in the same class or by combination of description and the mention of three or more names of manufacturers as standards. In the first instance it is difficult in a rapidly changing market to anticipate patented features which may limit competition. The mention of names of manufacturers as standards has an advantage of portraying a positive opportunity for competition. However, a sufficient number of mutually competitive firms must be mentioned, and unless three or more names can be stated, it is better to rely upon descriptive specifications. Even when clearly stated that it is to be used only as a standard, the mention of only one name usually impairs competition seriously.

In certain instances patented apparatus and treatment methods are such that to obtain competition it is necessary to resort to alternate proposals. In such cases the shrdlu cmfwyp cmfwypcmfwyp cmfw cmfwy cmfwyppp engineer should draw complete plans and specifications clearly to define the alternate method or apparatus. Price bid must determine the award with all other considerations clearly covered in the specifications.

Frequently, initial cost is not the major consideration, and variations in operating cost affect the ultimate economy. If operating cost is to be considered in the award a definite basis for computing ultimate economy should be clearly outlined in the specifications and set forth in the proposal. In order to protect against an irresponsible quotation on operating cost it is desirable to require a bond for performance to be determined by carefully specified tests.

Fair and effective competition possesses the following attributes. To the engineer it affords the very basis of his existence, and the opportunity for independent practice with high respect of the public; to the contractor, freedom of opportunity and a reward for efficiency; to the manufacturer, independence in business and marketing, and a stimulus to improve products and develop new and better methods; and, to the taxpayer dollars and cents in economical public works.

QUALITY, ACCURACY AND SIMPLICITY REQUIRED IN ENGINEERING AND SURVEYING INSTRUMENTS

By LOUIS H. BERGER
President of C. L. Berger & Sons, Inc., Boston, Mass.

IN ORDER adequately to fulfill the needs of this unparalleled period of scientific learning and industrial achievement, the making of the necessary efficient and accurate instruments cannot, by its very nature, employ the methods of mass production which lessen the cost of other standard products. The manufacture of real precision instruments—transits, theodolites, alidades and precise levels—is an exacting service. It entails the employment not only of workmen who are carefully selected, expertly trained and skilled, but also that of especially fine and very costly machinery.

The highly skilled individuals employed in the manufacture of precision instruments cannot properly work on a piecework basis and should not be "rushed." Workmen possessing such intensive skill deserve and command high wages and also the shorter day which, in the human equation, is in fact a contribution to the excellence of their product.

The employer makes no concession when desiring competent design or direction. Why, then, should there be, on the part of engineer or employer, any concession as to equipment, when the difference between the cost of a perfect instrument and of one not so good is so relatively small?

A condition now so manifest that it is assuming the proportions of a vexatious problem is that caused by the errors that have been and are in some places still being made in the surveying of municipalities and land properties. Although crude methods were deemed sufficient in the early periods, recent developments have revealed their weaknesses, and a necessity for a precise standard of surveying in place of that which has so long prevailed.

Of late years, a sense of insecurity or of loss has possessed many a landowner. He finds that, because of errors over which he had no control, he may be occupying land he does not own, or may be rightfully entitled to land on which others have built. Uncertainties of boundary give rise to both these possibilities.

Such conditions are especially serious where land once accounted of little value suddenly becomes definitely valuable. This type of land has usually been poorly surveyed. If precise methods had been used when the original surveys of such properties were made, numerous inevitable and costly lawsuits would have been avoided. To make precise surveys, it is necessary to use instruments of precision. Surveys are no longer made with rude compasses, and transits of uncertain accuracy are steadily being discarded. A precise survey, once made, is a monument—a criterion to which all succeeding work may be referred.

The Land Court in Massachusetts insists on surveys of high precision, such as are obtained only with accurate instruments. These are required so that, for instance, any large plot originally land-courted may be subdivided and automatically registered without any further court proceeding.

The advances made in the manufacture of precision instruments have been great. Their telescopes, to take one instance, are highly illuminated, and have unusually sharp definition and a flat field of view. The powers of the different types of telescopes are consistent with the instrument, and the line of sight is accurate for all distances. In the design of modern engineering and surveying instruments, as in that of many mechanisms, simplicity triumphs over complexity where practical service is the referee.

A recent tendency in the manufacture of such instruments, in America as well as abroad, has been the abandonment or the ignoring of designs characterized by simplicity, and the substitution of designs that are far more complicated. The claim is sometimes made that the complex designs insure accuracy and speed in the manipulation of the instrument. The fact is that the number of parts has been greatly increased in an attempt to accomplish in a different way what instruments of reputable make and simple design have always been capable of doing.

The basic principles of instrument design are a development of many years, and several so-called new inventions can be traced back as far as a century and a half ago. Doutbless their reintroduction has been in many cases due to independent thought and action which might have been saved by a study of the annals of the instrument-making profession.

More and more is the fact realized that engineering and surveying instruments, especially those employed in cities, on highways, on railroads and in mines, should be of simple construction, and free from complicated attachments since these are often a hindrance to the user, instead of a help. In what are even in these days great distances, the time and expense involved in returning a complex instrument to the manufacturer would often be prohibitive, and many a nearby shop that might easily repair an instrument of simple design would not be equipped with adequate auxiliary optical apparatus or trained men to make complete adjustment of the intricate parts of vital importance to the performance of the instrument.

It is advised by you who teach surveying and engineering that the surveyor should not only be able to adjust the instrument he is using but should also be able to make adequate emergency repairs. Every increase in complexity of design renders the instrument-user less able to adjust and to repair his instrument.

The engineer operating with a time penalty in his contract is in sore straits when he is forced to send an instrument to the factory for repairs because of minor disarrangement of delicate trains of prisms and gears.

To lighten the weight of an increased number of parts, aluminum and its alloys are used. The saving in weight is often detrimental to the accurate performance of an instrument, especially in high winds. That stable metal,

bronze—time tested and proved to be the best material for the construction of the instruments—has reached a high degree of perfection through recent advances in metallurgy.

When, in the important projects of modern engineering, the possible humiliating, expensive, dangerous and often disastrous consequences of even slightly inaccurate measurements are considered, the tremendous importance of instruments of a precise standard is readily recognized. The American trend has been toward expediency without the slightest sacrifice of accuracy. To bring about this consummation, a manufacturer employs simplicity of design wherever it makes for efficiency and where it eliminates the high cost of repairs or adjustment. He also employs ruggedness of construction where it increases usefulness and minimizes repairs. He concentrates into these qualities a precision of performance commensurate with the instrument, and is thus assured that his market is being constantly satisfied.

The technical educational and engineering professions have found, over a period that touches both of the world's great centuries of mechanical and engineering achievements, that nothing less than the highest standards of perfection can accomplish the great feats for which modern engineers and surveyors are responsible. There is no substitute for precision.

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Nation-Wide Trend Toward Ear-Marking of Automotive Tax Revenues

A study of the use made of automotive tax revenues in the 48 states and the District of Columbia reveals a nation-wide trend toward the ear-marking of all motor vehicle tax revenues exclusively for the administration, construction, and maintenance of highways and bridges, the American Petroleum Industries Committee reports. The trend is shown by the increasing number of states adopting constitutional amendments and statutes prohibiting the diversion of highway funds, in the large number of states that have abolished such diversion in the past two years, and in the substantial reduction in the amount of highway money that is being misused in other states, the Committee says.

By the end of 1935 Colorado, Kansas, Minnesota, and Missouri had amended their constitutions so as to safeguard their road funds. In 1936 the people of Maine, facing a threat of diversion, voted by a majority of three tc one to reserve all automotive taxes in the future for highway use.

The greatest progress against the misuse of highway funds was made last year, however, when the North Dakota legislature passed a law and the legislatures of Alabama, California, Indiana, and Nevada voted favorably on constitutional amendments designed to protect their highway revenue. More recently, a constitutional convention meeting in New Hampshire approved a similar amendment, which the people will be asked to ratify at a general election in the fall.

In New Hampshire, as in Alabama and California, where the people will also be asked to ratify the proposed amendments at the polls this fall, there is every expectation that the voters will favor this means of protecting their road funds. In Indiana and Nevada the adoption of a constitutional amendment involves its passage by two successive legislatures before it is submitted to the voters, so that another twelve months must elapse before the people of these states will have an opportunity to express their approval of ear-marking highway funds.

29,705,220 Motor Vehicles Registered in 1937

Motor vehicle registrations in 1937 amounted to 29,705,220—an increase of more than 1,539,000 over the preceding year, according to state reports to the U. S. Bureau of Public Roads. There were registered 25,405,728 automobiles, 4,255,296 trucks, and 44,196 busses.

Registration receipts totaled $337,410,000. Other receipts for permits, certificates of title and from miscellaneous sources brought the total to $399,613,000. Additional payments to states by motor carriers, such as taxes on gross receipts, ton-miles, passenger-miles, and as special license fees and franchise taxes, amounted to $16,216,000.

According to the Bureau of Public Roads, highway usage increased not only because of the presence of a million and a half additional vehicles, but because of increased use per vehicle. This is indicated by an increase of 7.6 per cent in gasoline consumed as compared with a 5.5 per cent increase in registrations.

MOTOR VEHICLE REGISTRATIONS IN 1937

State	Vehicles Registered	Increase or Decrease in Registration, Per Cent	Registration Receipts and Miscellaneous Fees
Alabama	313,359	5.4	$ 4,439,000
Arizona	129,210	12.3	1,143,000
Arkansas	229,867	5.8	3,241,000
California	2,484,653	6.7	24,003,000
Colorado	337,217	6.7	2,603,000
Connecticut	436,564	8.3	6,691,000
Delaware	63,599	6.7	1,202,000
Florida	418,145	8.1	6,196,000
Georgia	441,847	7.6	2,368,000
Idaho	142,110	6.8	2,498,000
Illinois	1,768,946	6.6	21,430,000
Indiana	956,016	5.6	9,827,000
Iowa	745,602	2.4	11,918,000
Kansas	586,685	1.5	4,537,000
Kentucky	404,455	8.6	5,125,000
Louisiana	323,498	7.0	4,710,000
Maine	200,907	4.9	3,865,000
Maryland	387,410	2.4	5,577,000
Massachusetts	846,556	3.7	6,875,000
Michigan	1,505,111	9.6	22,085,000
Minnesota	822,598	5.0	8,867,000
Mississippi	226,286	9.9	2,248,000
Missouri	835,895	3.2	9,638,000
Montana	173,892	4.0	1,532,000
Nebraska	412,726	*—0.3	2,603,000
Nevada	40,655	5.6	282,000
New Hampshire	125,939	3.0	2,347,000
New Jersey	994,497	5.4	19,271,000
New Mexico	118,106	8.6	1,544,000
New York	2,561,703	4.4	52,901,000
North Carolina	525,350	4.1	8,855,000
North Dakota	173,188	3.6	1,581,000
Ohio	1,876,132	5.6	25,635,000
Oklahoma	547,263	2.9	5,584,000
Oregon	360,348	8.3	3,378,000
Pennsylvania	1,984,821	6.9	38,332,000
Rhode Island	167,586	5.3	2,790,000
South Carolina	296,224	6.2	1,690,000
South Dakota	184,743	*—0.0	1,650,000
Tennessee	400,384	5.1	4,233,000
Texas	1,552,114	5.0	19,684,000
Utah	126,692	8.5	1,049,000
Vermont	88,958	5.7	2,410,000
Virginia	440,713	5.6	6,153,000
Washington	535,483	7.1	4,402,000
West Virginia	290,837	3.9	6,162,000
Wisconsin	854,374	2.3	12,984,000
Wyoming	81,837	6.8	597,000
District of Columbia	184,119	1.5	878,000
Total or Average	29,705,220	5.5	$399,613,000

*Decrease.

MAINTENANCE OF BITUMINOUS SURFACES

A Review and Condensation of Eleven Papers Submitted by the Committee on Maintenance at the 1938 Montana National Bituminous Conference

By A. B. NUSS
State Highway Engineer of Kansas

Maintenance Organization—Gangs vs. Section Crews

MR. FORRER, Maintenance Engineer for Virginia, has expressed the opinion that there is a place for both gang work and section crew or patrol units.

Gang maintenance is, according to Mr. Forrer, best suited to roads not highly improved, that require such work as replacement of materials, ditch work and gradual improvement of the surface. One objection to the patrol system is the inefficiency during periods when the weather is dry and the roads smooth. By combining five or six patrolmen into a gang during such periods of inactivity, pits and crushers may be operated and much work performed which would be impossible with an exclusive patrol system. These gangs can be returned to small units when the weather and road conditions demand.

The section crew is best suited to higher type roads which have been properly constructed, each crew taking care of about a 60-mile section.

Mr. Forrer believes that considerable latitude should be given the maintenance engineer to set up the organization best suited to the conditions.

The Montana organization, according to Mr. W. J. Leary, Division Engineer at Butte, is organized with both section crews and gangs. The sectionmen handle all regular routine maintenance over their definite section.

During the spring and summer months, special crews are sent throughout the state to do different types of special work. In this manner, the advantages of both organizations are secured.

Mr. Reindollar, Assistant Chief Engineer of Maryland, recommends a combination to suit conditions with section crews for routine maintenance and gangs for extraordinary or special maintenance such as resurfacing of sections too small to contract.

Conclusion—Both types of organization apparently have a place in a maintenance department with work of the special gang most often supplementing that of the sectionman or crew.

The members of the Committee on Maintenance, of which A. B. Nuss is chairman, who prepared papers, consists of W. H. Root, Maintenance Engineer, Iowa State Highway Commission; A. D. Stanley, Construction and Maintenance Engineer, Idaho Department of Public Works; S. M. Rudder, Assistant Chief Engineer, Missouri State Highway Department; F. H. Klietsch, Maintenance Engineer, Nebraska State Department of Roads and Irrigation; J. J. Forrer, Maintenance Engineer, Virginia Department of Highways; W. J. Leary, Division Engineer, Montana Highway Department, Butte, Mont.; B. G. Dwyne, Assistant State Highway, New Mexico State Highway Department; R. M. Reindollar, Assistant Chief Engineer, Maryland State Roads Commission; Dudley H. Jones, Maintenance Engineer, Oklahoma State Highway Commission; D. D. Williamson, District Engineer, The Asphalt Institute; A. L. Tregillus, Asphalt Engineer, Provincial Department of Public Works, Edmonton, Alberta; W. J. Slavin, County Highway Engineer, Livingston County, Michigan.

Proper Decision as to Whether to Patch Seal, Remix, Retread or Replace Bituminous Surfaces

Proper decision as to whether to patch, seal, re-mix, retread or replace bituminous surfaces was answered by five members of the committee. From the answers it appears to be well agreed that an analysis of figures and the extent of necessary repairs are the primary factors in determining the type of repair.

Mr. W. J. Slavin, County Highway Engineer for Livingston County, Michigan, believe that finances and economics determine largely the repairs to be made. Patching is permissible within reasonable limits, but where excessive, either the thickness of the surface should be increased or the stability of the base increased to carry the load.

Mr. F. H. Klietsch, Maintenance Engineer for Nebraska, divides the factors which will affect the decision as to time and method of repair into two classes: direct, or those based on an analysis of actual conditions, in indirect, or those based on finances and facilities available for making the repair.

As an analysis of actual conditions, Mr. Klietsch recommends that an investigation of the cause of failure be made before repairs are made, as to whether subgrade, base or surface is the cause of failure. Determination of the true cause of failure, and its correction, will eliminate, to a great extent, repeated failures after repairs have been made.

Mr. D. D. Williamson of the Asphalt Institute states that four main factors should be considered:

1. Earning capacity of the road.
2. Available finances.
3. Condition of base.
4. Surface and percentage needing repairs.

On the latter, Mr. Williamson believes that, in general, a general repair is necessary when 25 per cent or more of the surface requires attention.

Mr. S. M. Rudder of Missouri outlines the factors affecting a decision as follows:

1. Classification as to base or surface failure.
2. Alignment factor, permanent or temporary location.
3. Influence of the season in which repairs are to be made.

Mr. Rudder believes that patching is one of the most expensive types of work, due to the hand labor in-

volved. The extensiveness of such repairs is therefore limited.

Conclusion—It appears to be well agreed that an analysis of the cause of failure should be a primary factor in determining the type of repair.

After the analysis, the type of repair will depend on cost and finances available, including the earning capacity of the road, whether a permanent or a temporary repair due to possible relocation or realignment is desirable, the facilities in equipment available for repair and also the influence of the season in which the repair is to be made.

Methods of Patching

(a) Pre-Mix vs. Mixed in Place on Heavy Mats and Light Surface Treatments.—Seven answers to this question were received.

Mr. Stanley, Construction and Maintenance Engineer for Idaho, favors pre-mix because less danger to public and workmen while placing, and because one skilled workman can produce enough material to keep several others busy.

Mr. Dwyre, Assistant Highway Engineer for New Mexico, favors pre-mix due to difficulty in obtaining proper mix in mixed-in-place. A stockpile is usually made at time of construction and used for repairs.

In Nebraska, according to Mr. Klietsch, all patch material is premixed by blades or traveling plant, with a stockpile of mixed material made at time of construction.

Alberta Province, states Mr. A. L. Tregillus, Bituminous Engineer, uses pre-mix for better control.

Mr. Leary says Montana used pre-mix material.

Mr. D. D. Williamson, District Engineer for Asphalt Institute, lists advantages of pre-mix as safety to public during repairs and easier to patch large areas.

Maryland apparently has been successful with both plant mix and mixed in place patches.

Conclusion: Pre-mix is considered generally to have a number of advantages over mixed-in-place. Among these are:

1. Safety to public and workmen.
2. Use of stockpiled material from construction.
3. More satisfactory material, better control of mix.
4. More economical to handle for large patch areas.

Several replies noted that the patch material must be the same as the original construction as to aggregate, and to a certain extent, the asphalt used.

(b)—Type of Bituminous Binder for Patching.—Idaho patches in kind—SC3 for road mix, MC4 for plant, SC3 where material is stockpiled.

New Mexico uses SC3 in colder sections of the state and in warmer sections uses MC.

Nebraska favors MC and SC for patches. It is noted that SC with absorptive aggregates becomes dry and unusable after a short time, although with non-absorptive aggregates it is satisfactory.

Alberta favors MC, but is trying SC again.

Montana is now favoring SC with RC1 as a prime.

Mr. Williamson of the Asphalt Institute recommends RC for premix and regular paving cement for hot patches.

Maryland uses RC2 for cold patches aging material 24 hours in stockpile before using.

Conclusion—Seven replies to this question were received. Three of these stated they were using both MC and SC, either to patch with an oil of the same type as in original construction; or using an SC in colder regions, with an MC in warmer regions; or investigating the relative merits of the two types. One reply definitely favored MC and RC for patching, although noting the advantages of SC for stockpiling. The fifth reply favored RC and penetration asphalt. The sixth was definitely in favor of SC, while the last definitely specifies RC2.

It appears, therefore, that SC, MC and RC have definite advantages, depending on conditions of stockpiling, weather and probably the skill of the workmen. SC apparently possesses some advantages over other materials, which tend to be offset by the difficulty of mixing in the proper proportions with the labor and equipment available.

(c) Methods of Mixing Patch Material.—In Idaho the material is usually mixed on a suitable piece of ground or abandoned roadway by motor graders. Occasionally a concrete mixer is used. They are trying to secure a number of small portable plants of about 100-ton daily capacity.

New Mexico uses motor graders, occasionally concrete mixers.

Nebraska uses blades or traveling plant.

Montana uses blades and patrols. Is also using small pugmill with dryer and mixer, with which each division is equipped. This is more expensive than blade mixing.

Mr. Reindollar of Maryland recommends stationary plants for large quantities, portable mixers for patching.

Conclusion—Mixing by blades and patrols is still the most common method in use. Occasionally concrete mixers are used.

There appears to be a growing tendency toward small portable mixing plants by which patching material may be mixed, especially under adverse weather conditions. Montana and Maryland are using plants of this type and Idaho is contemplating their use. There is a need for equipment of this type.

(d) Length of Time Material May Be Stockpiled.—Seven answers were received to this question.

Idaho expresses a limit of two years on stockpile. They seal the outside of the stockpile with SC or a cutback, or an alternate of a three inch sand blanket.

New Mexico uses in colder sections SC3 piled for over 18 months. In warmer sections, MC is stockpiled 3 to 6 months, but gets hard.

Nebraska says MC is stockpiled and is good up to four years. SC with a non-absorptive aggregate may be good up to seven years.

Alberta says MC is stockpiled up to ten days while SC has been used up to two years, although the material had hardened to a certain extent.

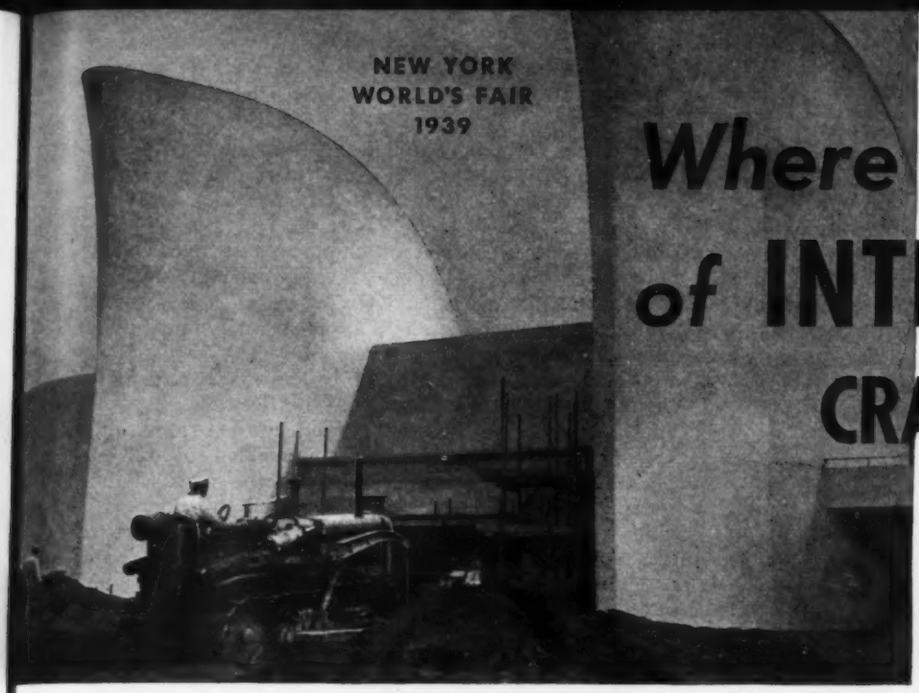
Montana says some SC materials mixed and stockpiled in 1930 are still usable.

Mr. Williamson of the Asphalt Institute advises that Oklahoma has stockpiled SC for more than a year, cutbacks and emulsions for 30 days.

Conclusion—The stockpile time of SC material apparently is more or less unlimited, periods up to seven years being reported with the material still usable. The quality of the asphaltic material and the protection of the stockpile probably affect this to some extent. The period of MC cutbacks is limited apparently to not more than one year, although one state reports MC usable after four years.

(e) Grading and Types of Aggregates for Patch.—Idaho uses same gradation in patch material as in mat with 100 per cent passing the 1 in. square sieve and not over 12 per cent passing the 200.

New Mexico conforms to original gradation except



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INTERNATIONAL INDUSTRIAL POWER

in some cases where maximum size is reduced from 1 in. to ¾ in.

Nebraska uses same gradation as original material.

Montana states early gradation was too coarse with not more than 65 per cent passing ¼ in. sieve. This was altered to 100 per cent passing ¾, 40 to 65 per cent passing the ¼ in. sieve, and 5-15 per cent passing the 200, which has given satisfactory results.

Alberta uses same gradation as original mat. Trend is to get away from densely graded aggregate, using material of which 100 per cent is retained on a ⅛ in. circular opening.

Mr. Williamson of the Asphalt Institute suggests relatively open mix.

Conclusion—In general, the same gradation of aggregate is used for patching as that of the original construction. In some cases, it has been found advisable to reduce the size of the coarse aggregate. (The Province of Alberta reports an aggregate of which 100 per cent is retained on a ⅛ in. circular opening screen.

Sealing

(a) Type and Grade of Bituminous Materials Used.—Six answers were received to this question.

Mr. A. D. Stanley of Idaho reports SC4 has given best results in Idaho under extreme heat and cold. Stone chips are used with this material, having not more than 8 per cent passing the 200-screen.

For sand cover, RC4 is being used. MC was found too slow in curing to prevent pickup under traffic and also tended to become hard and brittle under low temperatures. The use of 95 plus asphaltic oil with special MC5 and RC5 cutbacks is contemplated.

Livingston County, Michigan, according to Mr. Slavin prefers a light seal of 0.25GSY of quick-breaking emulsion. 0.1G.S.Y. of MC2 with a sand cover is also used.

In New Mexico materials of SC, MC, RC and 250 penetration asphalt are used. SC is used on surfaces which have dried out and on older surfaces. RC3 is objected to due to hardness and brittleness. MC3 is used on new surfaces and porous surfaces.

Mr. Kleitch of Nebraska says RC1, RC2, and RC3 from 0.15 to 0.30 G.S.Y. are used in there dependent on type of surface. MC2 is used on SC mats for sealing.

Mr. S. M. Rudder, Assistant Chief Engineer of Missouri divides sealing roughly into two classes, those with little or no cover, and those which utilize substantial amounts of cover. For the former both MC and RC of low viscosity are used. For the heavier type, heavy cutbacks and high penetration asphalts are used.

Conclusion—It appears that nearly all types of asphaltic materials are being used, from SC, MC, RC and penetration asphalts to quick-breaking emulsions.

One state, Idaho, has had excellent results from SC4 as a sealing material, while there is a decided increase in the use of heavier cutbacks of MC4 and RC4 grades, and high penetration asphalts applied hot. A tendency toward heavier cutbacks than the four grade is also noted in the paper by Mr. Stanley of Idaho, in which the use of a special MC5 and RC5 for sealing is contemplated.

There is a tendency to choose the asphaltic material to suit the peculiarities of each surface; if the surface is porous or loose, a material which will penetrate this surface, such as an SC, MC2 or 3 or an RC1 or 2, is used. On dense surfaces, heavier grades are used.

(b) Methods of Applying Cover Material.—Idaho recommends spreader boxes. They also have used with success a "turkey tail," a steel plate with radiating blades or fins.

Mechanical equipment and large units tend to eliminate the personal equation and results are better.

Mr. Slavin of Michigan uses a homemade revolving disc spreader.

New Mexico uses sand or chip spreader, suspended or fastened to back of truck. Avoids marking surface, more convenient and safe.

Nebraska uses sand spreaders. More economical than hand spreading, more uniform.

Missouri uses mechanical spreaders to secure uniform distribution. Brooming may be desirable.

In Maryland fan spreaders used most extensively.

Conclusion—Spreaders are recommended by all of those answering this question. In some cases, hand spreading is performed, but mechanical spreaders of various types are more economical, safer and produce a much more uniform surface, and seem to be preferred. No definite mention is made of preferences for specific types of mechanical spreaders of which there are several types. There should be discussion of the relative merits of truck propelled or self-propelled rotating type spreaders as compared with box type and of agitating vs. non-agitating types. Rollers are recommended by Idaho and Missouri; Missouri recommends tandem or three wheel over five tons.

(c) Methods and Types of Plant Mix Seal Mixtures.—New Mexico has been using natural rock asphalt with 3 per cent natural asphalt content and 2 per cent additional bitumen. The grading is very fine and produces a smooth rubbery surface. Use 300 to 450 tons per mile with an average thickness of ½ to ¾ in.

A tack cost of 0.10 G.S.Y. of RC1 is necessary when used as a seal.

Missouri has used an amesite mixture on two miles of old oiled mat. The seal varies from 2 in. over several ⅛-mile sections, to ¾-in. thickness over others. The appearance is good.

Maryland uses Maryland "C" specification similar to amesite mix very satisfactorily.

Conclusion—This type of treatment in most localities apparently is largely experimental.

Shoulder Maintenance of High Type Bituminous Surfaces

(a) Rolling: Weight and Type of Roller.—In Virginia four types of shoulders are considered with type of treatment for each. These were classified as:

1. Earth from regular excavations.
2. Earth from selected materials.
3. Soil that will support grass.
4. Bituminous sealed type.

For earth shoulders of Type 1, compaction with a roller is beneficial. The roller should weigh not less than eight tons. Type 2 may be compacted in like manner. Type 3, the grass shoulder, requires no other than original rolling. Type 4 is ideal (bituminous sealed type.)

(b) Sealing of Shoulders Justified.—Mr. Forrer of Virginia feels that shoulder treatment as described is well worth while. For effective sealing of the shoulder, the material in the shoulder should be suitable. Under the conditions, sealing of the shoulder is an ideal solution.

Traffic tends to use the shoulders after treatment and wear occurs. The solution tends to be temporary.

(c) Would Saving Justify Full Width Construction?—Mr. Rudder of Missouri believes that bituminous treatment of shoulders is economically justified as well as full width construction.

Exclusive with Brick

1 A FACTORY-MADE SAFETY SURFACE
2 PROTECTS AGAINST *Both* WEATHER & TRAFFIC
3 LONGEST LIFE AND LOWEST UPKEEP

afety surface of brick is precision-made dern factories. Nothing is left to chance.

e the surface and you save all" applies avements, too. A brick surface defeats her damage.

pavements built for horse-drawn vehicles instead carried motor traffic for 40 years re still in service.

161st Street, The Bronx, N. Y. C.

Brick offers exclusive features in safety and economy.

A brick pavement is the only pavement that has a *factory*-made safety surface. The coefficient of traction is high. The pavement surface may be inspected for safety before it is laid.

Never has safety on the highways been so important as now. Likewise, never has long pavement life and low upkeep been so important as it is today.

Brick cost less—far less—per year of service. Their life is generally in excess of 30 years. The upkeep costs are low—often nil after years of hard usage. The reason: brick protects against weather as well as traffic damage. Damage by weather roughens pavements and brings on destructive impact from traffic.

If your paved roads and streets cost too much for upkeep and must be replaced too often, begin a program of resurfacing with brick—protect new pavement with a brick surface! It saves money. National Paving Brick Association, National Press Building, Washington, D. C.

BRICK

FOR NEW CONSTRUCTION OR RESURFACE JOBS

General Conclusions on Shoulder Maintenance, High Type—This question was discussed in length by Mr. Forrer of Virginia. Mr. Forrer has classified four types of shoulders and the general treatment of each.

When the soil of the shoulder is of the proper type, rolling is of considerable importance, with an eight ton roller recommended.

Sealing of earth shoulders is of temporary value when soil conditions are favorable.

If a shoulder has a good surface traffic tends to use it with resulting wear. It is inferred that full width construction may be effective and the cost justified.

Shoulder Maintenance for Low Type Bituminous Surfaces

(a) Rolling: Weight and Type of Roller.—Mr. Slavin, County Engineer of Livingston County, Michigan, believes that adequate width of surfacing and thickened edge construction of mat with a "V" channel in the subgrade at the edge, with a well trimmed berm (shoulder slope) will minimize edge failures. Rolling is not discussed.

Mr. Rudder states that the following system is used in Missouri with excellent results:

Shoulders are built up to map levels at the time of construction. Experiments with low shoulders (not built up) did not prove satisfactory from either appearance or elimination of edge failures. This applied to both high and low types.

Ruts are eliminated by dragging, with particular attention during winter and spring months. In the spring, shoulders are rolled with a 36 in. wide roller having a pressure of from 120 to 130 lb. per inch of width. A shoulder slope of at least ½ in. per foot is maintained. The intensive work during this time of year considerably lowers maintenance costs during the remainder of the year.

Conclusion on Rolling—The experience of Missouri and, it is believed, many other states, indicates that rolling of the shoulders is of considerable value in reducing maintenance both of the shoulder and of the mat or other bituminous surface.

(b) Sealing Economically Justified.—In the opinion of Mr. Rudder of Missouri, the sealing of shoulders on low type of bituminous surfaces is economically justified, in that with each increase in width of primed and surfaced base, maintenance work along the edge has decreased. Sealing the entire width has produced a noticeable effect in reducing shoulder maintenance.

The shoulder may be protected by either oiling or an armor coat.

Conclusion—It will probably be agreed by many that protection of the shoulder surfaces will lead to decreased maintenance through less shoulder erosion and edge failure of the bituminous surface.

Present methods of penetration alone do not always work satisfactorily, but through soil selection or stabilization with aggregate and/or oil, or by placing an armor coat on the shoulder as suggested by Mr. Rudder, very serviceable shoulders may be produced which will yield good returns in decreased maintenance of the surface.

(c) Would Saving in Maintenance Justify Constructing Surface Full Width of Roadbed.—Mr. Rudder from Missouri believes that full width construction would create substantial savings in maintenance and justify the additional cost and time.

Reconstruction of Failed Surfaces

(a) Where Failure Is Due to the Surface Itself.—Mr. Klietsch of Nebraska classifies two groups for roconstruction: one with little or no special maintenance; the second with considerable special maintenance. The first group appears to be primarily those of surface failures. The treatment given is to tear up the surface and blale it to one side, allow the subgrade to dry, correct oil deficiency in the surface material, adding RC2 to SC mat and MC to MC mat, and then relaying.

Mr. Root, Maintenance Engineer for Iowa, believes that most failurs occur in the base, and that the base difficulty must be completely cured before a permanent repair can be made.

According to Mr. Rudder of Missouri reconstruction of the surface should be made in accordance with the cause of failure. More bitumen may be added to dry mats and bitumen in mat may be reduced by addition of the proper dry aggregates. Difficulties in gradation should be corrected with additions of proper materials.

Conclusion—Failures of the surface course may be corrected, in general, by supplying the deficient factor responsible for the failure. Where the base or subgrade is not at fault, it is indicated that a reprocessing of the mat is favored as the correct procedure. In some cases increased thickness may be necessary, (see Maryland.) There are limits, however, to the extent to which such reconstruction can be carried.

(b) Where Failure Is Due to Subgrade Distortion or Shifting of the Base.—In Nebraska, surfaces which have failed due to the subgrade, are removed from the roadway and either stockpiled or windrowed. The base is then stabilized.

The stabilization method used is determined by an analysis of the subgrade composition. In most cases, a stabilized gravel mat is constructed using new materials. From 3 to 5 in. of stabilized gravel base is constructed on A6 or A7 soils. No definite formula is used to determine the thickness; engineering judgment is depended on.

Bituminous stabilization is used on sandy and silty soils economically suited for this type. The depth of this form of stabilization depends on the quantity of the material in the subgrade soil that passes a 200 mesh sieve. Three inches are sufficient where 20 per cent to 40 per cent passes the 200, and 4 to 5 in. are used where 10 per cent to 20 per cent pass the 200.

When mats are reworked, the gradation and oil content is corrected if necessary, and the mat relaid. Stronger mats are secured from old SC mats by addition, where necessary, of an RC cutback.

Where the subgrade material is sandy and contains insufficient fines, the fines are added to increase the stability. In some cases, sandy soils may fail, due to loss of moisture, and can be corrected by restoring a normal moisture content (3 per cent to 5 per cent).

Iowa suggests correction of the difficulty causing base or subgrade failure and mentions in particular excess loading.

Mr. Rudder of Missouri lists as causes of subgrade failure (1) surface water and (2) underground water. The former is corrected and cured by restoring the subgrade to proper conditions and then protecting by seals, the surface and shoulders. Ditches are cleaned to facilitate rapid run-off.

Failures due to underground water can be corrected if the source of the water is found and drained. If this is not possible, the faulty subgrade material should be removed and replaced with proper material, or at the area bridged by a heavy base. The latter is usually more practical.

(*Continued on page* 61)

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On construction jobs, in power plants, in the woods and on the farm, "RPM" Diesel Engine Lubricating Oil is helping Diesel tractor owners to earn more profits.

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"RPM" Diesel Engine Lubricating Oil is also available through distributors in more than 100 other countries.

Get in touch with your nearest distributor—for a clean engine, and long hard service with the minimum of overhaul.

Mr. W. J. Slavin of Michigan has reconstructed failed surfaces by removing objectionable material from frost heave areas, and then scarifying the old surface and base to depth of 6 in. One and one-half gallons, ine one case of SC3 and in another MC2 were added to the scarified material and mixed with blades. The mixed material was spread and rolled by trucks in two lifts with a final rolling with a seven ton tandem. The reconstruction has not been down for a sufficient time to draw definite conclusions.

Conclusion—Reconstruction methods vary with the locality and cause of failure.

Nebraska and Missouri, in their comment on reconstruction, indicate that the surface material is removed (and salvaged), the subgrade placed in proper condition and the surface material replaced, applying whatever correction of oil or aggregates is necessary to the surface material.

Mr. Slavin of Michigan describes a method of incorporating the surface material with subgradė material, plus a quantity of oil, forming a stabilized or semi-stabilized subgrade which is then given a light surface treatment.

Nebraska utilizes several methods of correcting subgrade difficulties, varying from simple correction of moisture abnormalities to more involved gradation correction for bituminous stabilization for sands and stabilized gravel mats.

Missouri also salvages the bituminous surface materieial which is relaid after correction of the subgrade difficulties.

Corrections of subgrade difficulties are made by removing the cause of the difficulty, usually exess water, or by either removing objectionable material or bridging such objectionable material with a heavy base.

Kansas has engaged in a heavy reconstruction season, in which the existing surface has been mixed with the subgrade and the whole sheepsfooted to a stable compaction, after which a penetration-armor coat has been applied.

General Conclusions

The methods of reconstruction vary with different localities, organizations and types of difficulties. Reconstruction of surfaces alone depends largely on correction of asphalt content or of gradation with the mixing and relaying of the surfacing material.

With subgrade difficulties, correction becomes more varied. The source of the difficulties, such as surface or ground water, may be eliminated as a simple solution. Sandy soils with insufficient fine material may be corrected by addition of the necessary fine material.

Subgrades with heavy soils may be stabilized to a degree incorporating the old bituminous surface, followed by sheepsfooting and compacting and then covering with a light surface treatment.

An alternate method is the bridging of unstable subgrade by heavy base construction of stabilized gravel mat, practiced by Missouri.

Stabilization of soils is being accomplished by cement and bituminous admixtures. Nebraska, particularly, has used bituminous stabilization for sandy soils to a considerable extent.

Some effort is being made to extend bituminous stabilization into heavy soils by the use of SC and MC, plus the stabilizing effect of aggregates from the old surfacing when rolled and compacted. Mr. Slavin of Michigan has experimented with this form of stabilization, as has Kansas. Missouri has had extensive experience with various methods of stabilization.

EDITORIAL

LESS COSTLY BRIDGES

IN THE October issue of this magazine we ran a provocative editorial on "More Bridges for Less Money." In it we took exception to some of the present assumptions upon which bridge design formulae are based. Since bridge engineers are the ones who use and apply these formulae we took the position that they are the ones who should demand better steels and higher stresses.

An upshot of the editorial is the following comment from one of our readers: "You have made the bridge engineers out to be a pretty sorry lot. Now, the next thing for you to explain is why some smart people, such as the writer of the editorial, have not taken our positions from us, since some bridge engineers draw very good salaries."

First of all, our inclinations lie in the field of sales promotion and marketing and we could not be driven to follow bridge designing as a vocation. Secondly, since we are endeavoring to promote extended and larger uses of commodities we look for those things which, if changed, might permit more sales, or more value to the public for their money. Our quarrel is with "accepted good practice," not with those men who must employ it. And they *must*. Since we cannot quarrel with the inanimate abstract, the point of contact for provoking discussion and consideration of that with which we disagree is the man who uses those inanimate abstractions.

Bridge engineers are *anything but* "a pretty sorry lot." However, they are shackled by a chain of "accepted good practice" and when they get into positions of responsibility they hide behind "screens" of conservatism. If we were a bridge engineer we would probably do likewise. That, however, is the factor which is responsible for the lack of progress in the development of new higher stress steels or the employment of higher unit stresses. Unless the bridge engineers or structural designers demand better commodities for steel bridge construction, who will?

It was the intention of the editorial in the October issue to jar bridge engineers hard enough to provoke discussion and, we hope, to initiate committee consideration. We have many good friends among the bridge engineers any one of whom knows more about the application of formulae in bridge design than we do; *but,* how many of them have taken time to consider ways and means of getting more bridges for the money? How many of them have promoted research work in an effort to discover a higher strength steel that would cost no more than the present grade of structural steel? How many of them have promoted research that would lead to the manufacture of non-corroding steel? How many of them have actually measured the so-called "impact" for which they are allowing some 30 to 40 per cent? How many of them have ever witnessed two maximum loaded trucks traveling at the most critical speeds dropping off of a brick, stick or other obstacle on the floor of a bridge at exactly the same instant under exactly the most severe load spacing conditions on the same structural member? So far as design assumptions are concerned, we question the probability of this condition ever occurring. The case is similar to the race track problem: If three horses start from the post at exactly the same instant and travel at different speeds when will they again be in a straight line at the post? Theoretically they will at some time, but practically, never. In the case of the trucks on the bridge, even if the trucks should load a bridge as allowed for in design formulae, the most destructive thing possible (not probable) would be to stretch some member, provided a stress twice as high as used at present were employed in the design of the bridge. It would be much cheaper to repair or even replace the distorted member than it would be to build so much excess steel in *all* bridges.

The problem of designing and building less costly bridges needs investigation.

▼

FOREIGN DRIVER ACCIDENTS

FROM three different sources we learn, without making any investigation as to the generality of the situation, that out of state vehicles create a higher percentage of accident rates than do vehicles licensed in a state. Undoubtedly this is due to unfamiliarity with the state highways on the part of out of state drivers.

There can be no stronger argument for uniformity of *adequate* signing throughout the entire country.

It reminds me of a situation I encountered in one of our large agricultural states. I was heading for a town we'll call Cameron. Going south out of a town 60 miles away to get there I got on the wrong road because of inadequate signing. I tried to cut across country to get onto the right road and shortly found that I apparently missed my goal. I stopped by a farmer leaning up against a corner fence post and asked which way it was to Cameron. He spat and replied, "I dunno." Then I asked which way it was to another town we'll call Wexo. Another spat and reply, "I dunno." So I asked the way to another town we'll call Ausso. Again he spat and replied, "I dunno." About that time I got exasperated and said, "You don't know much of anything, do you?" He spat, as usual, and replied, "Nope, but I ain't lost."

In this case I was lost due to non-uniform, inadequate signing. Perhaps this is also the reason why out of state drivers are prone to create a higher accident rate than local state drivers.

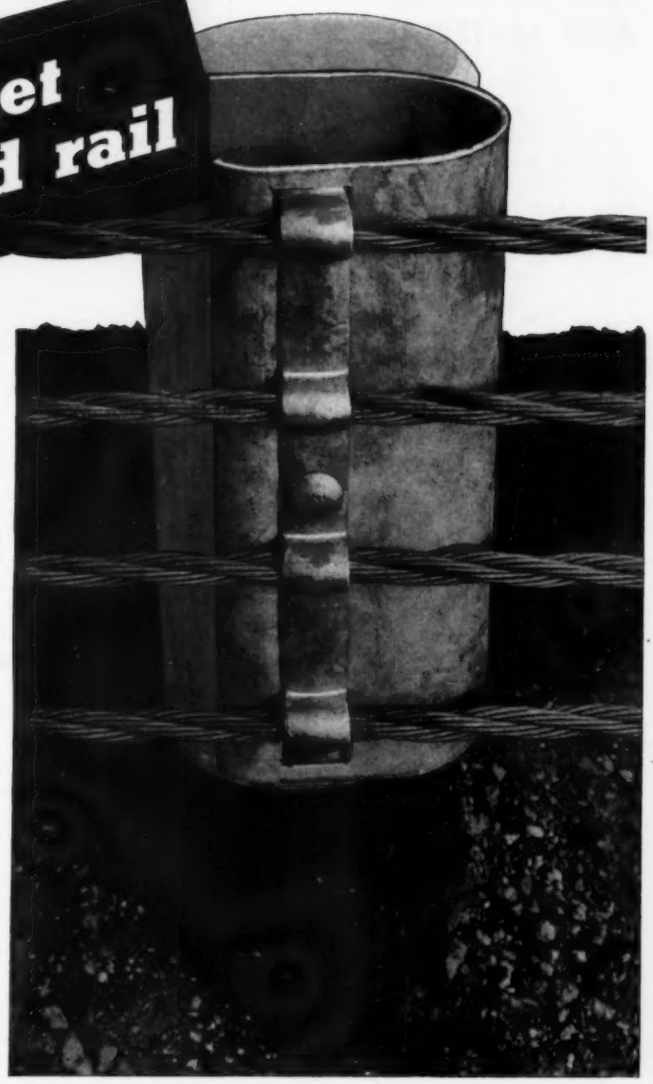
▼

ABOUT JOINTS

MANY different kinds and types of joints for concrete paving have been and are used. Many others have been proposed. The wide variation in these indicates that at present there is no common understanding of what a joint in a pavement should do; forces it should satisfy.

A comprehensive research project should be established so as to ascertain the function of a joint and the engineering principles involved in their employment. Who knows more about joints than those who manufacture them? In any research projects on joints, aggressive manufacturer's engineers should be members of the committee working on the problem.

A new bracket for cable guard rail



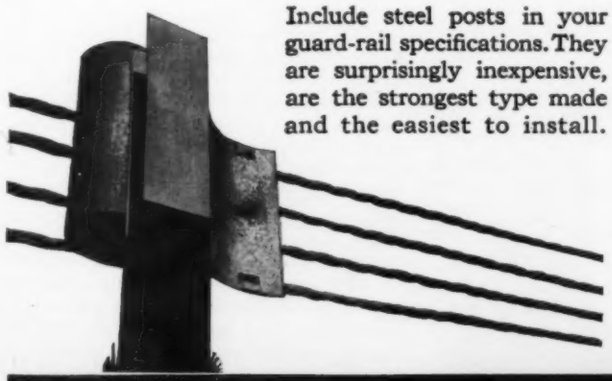
—that cuts costs

THE new Bethlehem spring bracket cuts six to eight per cent from the cost of cable guard-rail material.

It is made of the same heavy spring steel as the standard Bethlehem bracket, with the same high-grade galvanizing and can be made to accommodate any number of cables. One bolt anchors it to the post; one clip fastened by a single bolt secures the cables. It is so designed that a vehicle cannot strike any sharp points or corners. The offset is sufficient to protect a car from striking the post.

This new low-cost bracket is one more good reason for specifying *cable guard rail,* the least expensive type of guard rail to maintain.

Bethlehem's guard-rail specialists will be glad to give you complete information on all types of cable guard rail, to meet any state or county specifications. They are experts on this subject and can help you plan special installations to meet unusual safety requirements.



Include steel posts in your guard-rail specifications. They are surprisingly inexpensive, are the strongest type made and the easiest to install.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

NEW EQUIPMENT AND MATERIALS

New Tractor

A new gasoline tractor, the Model "S," has been announced by Allis-Chalmers Manufacturing Co., Milwaukee, Wis. This new machine is much the same in appearance and performance as the Model "S-O" controlled ignition oil tractor which has been a leader in the A-C crawler tractor line for several years. The Model "S" develops 77.66 H.P. on the belt, 64.52 H.P. at the drawbar and 16,732 lb. drawbar pull in first year. The constant mesh transmission provides five forward speeds from 1.52 to 6.37 miles per hour, and the constant mesh feature makes it possible to shift

Model "S" A-C Tractor

"on the go" like a truck. The tractor is offered in two tread widths. The 62-in. tread model has a shipping weight of 18,200 lb. while the 74-in. tread machine weighs 19,000 lb. A new four-cylinder valve-in-head gasoline engine has been developed by Allis-Chalmers for the Model "S." The bore is 5¾ in., the stroke 6½ in., and the governed speed at full load is 1,050 r.p.m. Like all other Allis-Chalmers engines it has removable cylinder lining and inserted valve seats.

▼

New Small Scraper

After months of experimenting and testing, R. G. LeTourneau, Inc., Peoria, Ill., has announced the latest addition to its family of earth-movers—the perfected Z Carryall. It is designed especially for small road projects and utility jobs, for use with D4 tractor. This carryall incorporates all the time and money-saving features of the larger carryalls. Struck capacity amounts to 2.7 cu. yd. and the heaped capacity 3.5 to 4 yds. Positive loading and ejection of the dirt is effected by the double cable action given by the double drum power control unit independently controlling the apron and tailgate. The bowl is self-cleaning, an exclusive carryall feature, and gives

Model Z Carryall Scraper

an even, controlled spread up to 14 in. in wet or dry material.

The carryall is stoutly constructed of special alloy steel used in a patented box-beam construction, arc welded together. The reversible, self-sharpening scraper blades are given a special heat treatment to permit long, efficient work in hard or abrasive materials.

▼

New 16½-Ton Truck Crane

A new heavy duty ¾-yd., 16½-ton crane capacity full revolving, mobile truck shovel-crane has been placed on the market by Bay City Shovels, Inc., Bay City, Mich. To obtain this capacity the manufacturer recommends truck having gross rating of 50,000 lbs., equipped as 6-wheeler with dual drive. The machine, which has been designated as Model 18, embodies the best features of Bay City design. The upper revolving turn-table and roller path of large diameter with internal ring gear are of unit-cast nickel manganese steel, reducing unnecessary dead weight but retaining all the advantages of one piece castings to absorb shock and vibration and to give stability. The liberal use of anti-friction bearings on all machinery shafts and in boom sheaves reduces power loss and assures maximum developed horsepower through quiet, smooth operating helical gears. All clutches and brakes are of the external contracting band type providing for easy adjustment and replacement of standard width lining. Hoist and auxiliary hoist are "E-Z" control booster operated which reduces operator fatigue. Other features include positive patented swing lock securely locking rotating base in any position of 360°. Patented electric dipper trip for shovel operation and self-locking boom hoist which raises and lowers boom under power. Cab

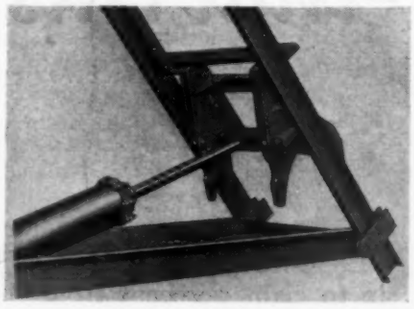
Model 18 Truck Shovel-Crane

is made of heavy 10 gauge formed sheets providing ample room for operation and completely enclosing all machinery. Shatter proof safety glass is used for protection and safety of operator. This machine with a swing speed of 5 R.P.M. is equipped with standard 30-ft. boom of heavy structural lattice type construction. Special alloy steel booms can be furnished with removable sections up to 80 ft. for high reach.

▼

New Models of Hydraulic Hoists

The Anthony Co., Inc., Streator, Ill., are now in production on six additional models of their "OK" low loading height hydraulic hoists and dump bodies. This completes their line of these "low loading height" hydraulic hoists and gives them eight models, ranging in capacity from five tons for the low price 1½ ton trucks up to 30 tons for the heaviest of heavy duty 6-wheeler trucks. Anthony Company claims that their telescopic frame principle enables them to give extreme low loading height without in any manner reducing sizes of structural



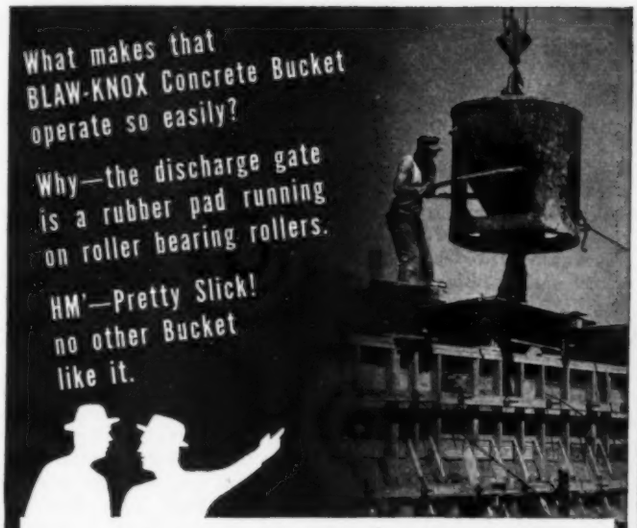
Principles of Operation of "OK" Hoist

members and thereby structural strength. They further claim for this line of hoists that they are "table" models, in that they are self-contained units and use the chassis frame in no manner except to carry the load.

▼

Worthington Offers Power Take-Off Compressor Mounting

To fill the requirements of a special field, Worthington Pump and Machinery Corporation of Harrison, N. J., has developed a portable air compressor with power take-off drive. Consisting essentially of a Worthington compressor driven through a Worthington Multi-V-Drive by a Hercules drive unit installed between the truck transmission and the front universal joint of the propeller shaft, the new unit combines maximum portability with utilization of a minimum of truck pay-load space. The compressor is the 3-cylinder 2-stage radial air-cooled type used on the standard Worthington portable mountings, and includes many modern features of construction: the improved Feather Valve, ring-type fins, large sectional type intercooler, articulated connecting rods, force-feed lubrication, and by-pass unloading.



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BLAW-KNOX *Roller Gate*
CONCRETE BUCKETS

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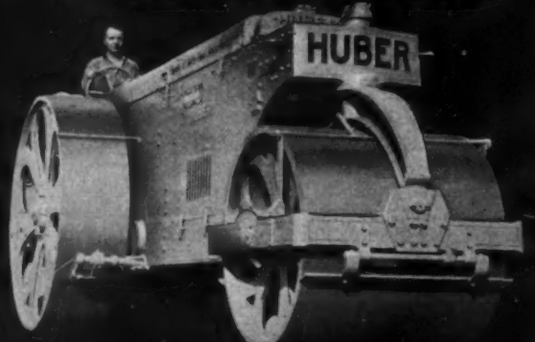

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FOR TRUCKS AND TRACTORS

With 21 models of truck plows—reversible, one-way, trip blade and "V" types—as well as many models for large and small tractors all hydraulic operated, you have a wide choice of dependable plows.

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2½ cu. yd.
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The new flat-angle hydraulic Scrapers, easily loaded to capacity with less power, dump cleanly and spread evenly. The two new models—190 and 210—really represent an entirely new idea in earth moving equipment.

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Baker Hydraulic, Direct-Lift Bulldozers and Gradebuilders, with many outstanding new models, continue to out-perform the field. Smooth operation, simple construction and tremendous down pressure are features which keep them in first place.

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New ¾-Cu. Yd. Excavators

A new general excavator in the ¾-yd. class—the General 41—has been announced by The General Excavator Co., Marion, O. The General 41 is characterized by high speed and mobility. Two travel speeds are obtained through speed change gears and in addition, the gasoline motor may be quickly accelerated at the will of the operator. Another feature of the "41" is its chain crowd. A split sprocket is bolted to the right hand drum shaft, and serves as a crowding unit. No special crowd unit need be placed on the machine. Boom is adjustable to all angles without affecting crowd chain tension. Retract motion—twice the speed of crowding motion—is obtained from a horizontal intermediate shaft which carries a friction clutch on one end, and sliding gears with selective jaw clutch. This same intermediate shaft also motivates the power boom hoist which is independent of hoist, swing and travel motion and is of the worm and gear type, oil bath lubricated. An automatic band brake on the worm shaft is an

New ¾-Yd. General Excavator

added safety feature. All high speed shafts are ball and roller bearing mounted. Alloy steels of special analysis are used throughout, wherever special characteristics of toughness, wear resistance or tensile strength are required. Hoist drum clutches and brakes are of the outside contracting band type with wide faces and large diameters for easy and efficient operation. Clutches are set by the General "Easy Touch" booster mechanism. Swing and travel motions are controlled by two friction reversing clutches of disc type. Selective jaw clutches are used to engage either the swing motion or travel motion. A new, fully enclosed stream-lined cab protects all machinery from theft and weather, provides complete accessibility to all parts and gives the operator full vision to front, sides and above, with plenty of light and ventilation. Glazed doors and windows permit operation in cold weather with perfect comfort. All controls are led to operator's station and can be reached from his comfortable, well-padded seat. Like all General Excavators, the General "41" can be changed from shovel to dragline, crane or other service on the job in a few hours' time.

Power, Gear Ratios, Capacities Varied in '39 Ford Trucks

A 1939 line of Ford V-8 trucks and commercial cars equipped with hydraulic brakes and comprising the widest selection of capacities, gear reduction ratios and power it has ever offered the transportation field, has been announced by the Ford Motor Co. With 42 body and chassis types, two clutches, five transmissions and eight rear axle ratios, in addition to various wheel and tire sizes which may be chosen, the line is designed to meet the requirements of more than 90 per cent of all commercial operations. Hydraulic brakes are engineered to conform with Ford design and practice, insuring quick stops with easy pedal pressure. Three V-8 engines are available for 1939. Heading the list is the new 95-H.P. engine with piston displacement of 239 cu. in. A number of refinements have been made in the 85-H.P. engine. The crankshaft is larger and heavier with diameter of main bearings increased to 2.5 in. The 112-in. wheelbase chassis has wide applicability through use of the 85 and 60-H.P. engines, three transmissions and three rear axle ratios. A 4.44 to 1 rear axle ratio is used with the 60-H.P. engine and a 3.78 to 1 rear axle ratio with the 85-H.P. engines. An optional rear axle ratio of 4.11 to 1 is also available. There is a choice between the low reduction 3-speed transmission ordinarily used with the 60-H.P. engine and the standard 3-speed transmission ordinarily used with the 85-H.P. engine. There is also a 4-speed transmission. The chassis is available with panel, stake, platform, pickup, sedan delivery bodies, as chassis with cab and in two driveaway types. A list of selections also prevails for the 122-in. wheelbase 1-ton truck. It is available with the 60-H.P. engine and a 6.67 to 1 rear axle ratio and the 85-H.P. engine with a 4.86 to 1 rear axle ratio. A heavy duty 4-speed transmission or either of two special 3-speed transmissions may be used with the 85-H.P. engine and a 4-speed transmission with the 60-H.P. engine. A choice of either the 85 or 95-H.P. engine is available with the 134-in. wheelbase and 157-in. wheelbase conventional trucks and all cab-over-engine trucks. There is also a choice between rear axle ratios of 5.14 to 1, 5.83 to 1 and 6.67 to 1. If still lower reductions are desired, a two-speed axle is offered with dual ratios of 8.11 to 1 and 5.83 to 1. The conventional 134-in. wheelbase chassis is available with panel, stake and platform bodies, as cab and chassis and in two driveaway types. The 134-in. wheelbase dump chassis is available with dump body, as cab-and-chassis and in two driveaway types. The 157-in. wheelbase chassis is available with stake and platform body, as cab-and-chassis and in two driveaway types. Introduced last spring, the line of Ford cab-over-engine trucks has been expanded by the addition of a 157-in. wheelbase unit. It is available as chassis with cab, and in a driveaway type. The 134-in. wheelbase cab-over-engine chassis is available with stake and platform body, as chassis with cab and in two driveaway types. The 101-in. wheelbase cab-over-engine chassis is available with dump, stake and platform bodies and in a driveaway type.

Ford V-8 Cab-Over-Engine Dump Truck

▼

New Closed Circuit Straight Line Gravel Plant

A new closed circuit straight line plant has been announced by Eagle Crusher Co., Inc., Galion, O. These plants are available in different sizes up to and including 10-36 crushers of modern design constructed with one-piece electric welded steel plate frames and anti-friction bearings. These crushers operate in closed circuit with elevator and vibrating screen producing a very uniform grade of material to the bucket elevator. This unit is mounted on a heavy duty 4-wheel steel truck obtainable with steel or pneumatic tire wheels, furnished with or without power. The Eagle portable straight line plant is provided with a

10x36 Straight Line Plant

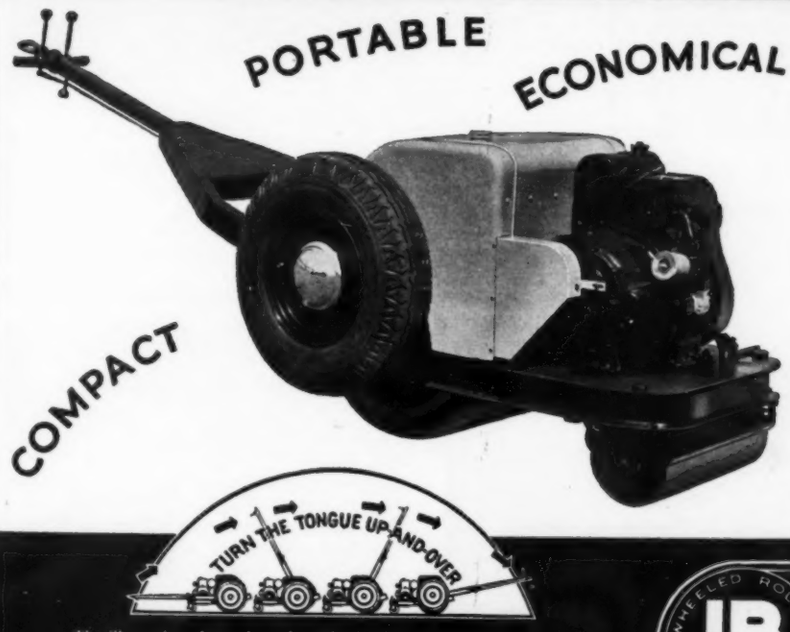
steel platform with railing permitting easy and safe access to feed conveyor control and screen while plant is in operation. Shown in illustration is a 10x36 plant weighing 31,600 lb. The plant is designed to operate with belt feed and discharge conveyors furnished in desired sizes.

▼

New Power-Charger

A new electrically started battery-charging plant of 12-volt, 300-watt capacity, known as Power-Charger Model 300, has been announced by Briggs & Stratton Corporation, Milwaukee, Wis. The generator is a specially built high-efficiency unit. Armature full ball bearing. Large capacity brushes. Fan cooled. Equipped with ammeter. Design of generator prevents burning out of armature if battery becomes disconnected in charging. Automatic cut-out prevents battery from discharging when hooked to idle unit. Multiple control switch has four positions for "start," "neutral," and a "high" and "low" charging output. A standard Briggs & Stratton Model IBP 4-cycle air-cooled motor, electrically cranked by generator through series winding. Motor speed automatically controlled by adjustable pneumatic governor. Standard equipment includes patented high tension built-in flywheel magneto, oil bath type air cleaner, gasoline filter, float feed carburetor, ball bearing drive shaft, screened blower housing.

ROLL *that* PATCH *with a* LITTLEFORD *Motorized* WHEELED ROLLER



The illustration above shows how the Model 150 Motorized Wheeled Roller can be turned from the trailing position to the rolling position. The large illustration shows the Model 150 Roller in the rolling position.

Road repairs made without rolling become a costly proposition. They absorb moisture, ravel, and finally break down. The practical and economical method is to make a permanent patch by rolling it with a Littleford Motorized Wheeled Roller. Rolling patches kneads the particles together making a solid mass which becomes a permanent part of the road itself.

The Model 150 Motorized Wheeled Roller will roll repairs and patches from small pot holes up to city blocks, used for shoulder widening work, replacing service cuts, rolling driveways, parking areas, and airports. *Model 150 can be trailed behind any truck as fast as it will go.* It is self-propelled, economical to operate, and easy to handle. Gives 150-lbs. compaction per inch of roller width with a total weight of 3,600 lbs. Write for details.

LB WHEELED ROLLER SINCE 1900 **LITTLEFORD**

LITTLEFORD BROS.
454 EAST PEARL ST CINCINNATI, OHIO

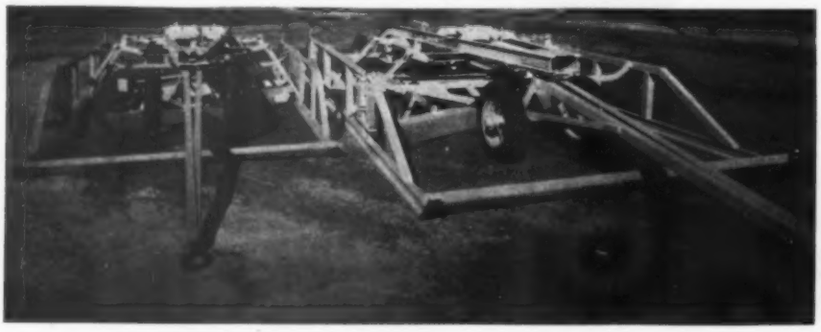
PULL *Extra* PROFITS YOUR WAY

Handle extra work with this high-speed Michigan Truck Dragline. Fingertip Air-Controls make possible more passes per hour — greater output per day — extra profits at the end of the month. Travels anywhere a truck can go — and with truck economy.

Rugged construction, from-the-ground-up, gives MICHIGAN the stability of heavier equipment and eliminates costly breakdowns and expensive schedule interruptions. Write MICHIGAN POWER SHOVEL COMPANY, Benton Harbor, Michigan.

Maintainers

A maintainer that is claimed to do perfect work at speeds up to 20 miles per hour, leaving no windrows, waves or corduroy, has been placed on the market by the Allen Road Machinery Corp., Montgomery, Ala. An exclusive feature claimed for this machine is the automatic control, the blade setting being controlled by the draw-bar pull without changing the contour or crown of the road for which the machine has been set by the operator. This, it is stated, saves considerably in upkeep of truck or tractor as it automatically regulates the quantity of material carried in blades to just the correct amount to put the road in perfect condition, without overloading, allowing the driver to devote his entire attention to driving, which makes it strictly a one-man machine. It is not necessary to lift blades when crossing bridges, culverts, etc., or when turning. The machine is controlled entirely by hydraulic pressure. Raising for transporting from one road to another, setting of blades, etc., is accomplished through a series of valves operated by a single pump, as no cup leathers or rings are used on the pistons, there is nothing to wear out or cause trouble and the simplicity of design makes it easy, even for a layman, to operate. The construction is entirely of standard angle and I-beam electrically welded together. Timken roller bearings in the wheels, regulation drop center rims and balloon type low pressure tires are standard equipment. The machine is built in two sizes. The standard machine is 7 ft. 6 in. wide, weighing 2,400 lb., requiring any 1½-ton truck or farm tractor to operate, and the heavy machine is 10 ft. 6 in. wide, weighing 5,500 lb, calls for a 4-wheel drive or a 3 to 5-ton rear wheel drive truck, or industrial type rubber tired tractor.



Standard and Heavy Type of Maintainers

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New Model Dempster Detachable Containers

A new model of the Dempster Dumpster has been brought out by Dempster Brothers, Inc., Knoxville, Tenn. In this new model by an exceedingly simple mechanism, the entire detachable container is carried forward on the truck chassis, thereby allowing larger capacities on smaller trucks. By an exclusive, patented, dumping mechanism, the contents are quickly discharged by levers operated from the cab, by the truck driver. The entire load may be discharged at once, or gradually, as desired. Chips may be spread evenly over a wide area, and the detachable container may be carried low to the ground, and be used as a spreader to more evenly distribute the dumped contents. The Dempster-Dumpster load forward model may be furnished in sizes ranging from 1 to 6 yds.

▼

Traffic Markers

A traffic marker that is claimed to give permanent year-round markings of high visibility has been placed in production by the Armor-Flex Co., St. Louis, Mo. This is a very hard yet flexible tile-like market set on the surface of the paving with a special asphaltic adhesive furnished with the markers. The markers are made in three standard colors—white, black and road yellow—3/16 in. thick. All letters of the alphabet are available in two types: elongated block type and smaller rounded block letters. Numerals of the long elongated type for speed limits and route numbers also are available.

▼

Attachments for Use With Patrol Graders

Two attachments for widening the range of work of the No. 10 and No. 11 auto patrols of the Caterpillar Tractor Co., Peoria, Ill., are illustrated below.

The snow, or street sweeping brush has, of course, a variety of uses, and can be installed in place of the regular blade. It is quite easily attachable and detachable, and has already had wide acceptance in metropolitan districts. It revolves through a universal connection from the transmission brake drum of the machine.

Auto Patrol with Snow Brush

Auto Patrol with Roller

The road roller, also easily attachable and detachable in place of the standard blade, can be used empty or filled with water, and utilizes the full maximum blade pressure of the machine.

▼

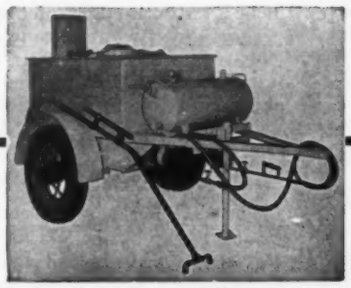
Engine-Driven Welder

A new welding unit for field and rural service where power supply is not available has been designed by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. This FlexArc Model SFA 200-ampere gas engine driven welder is completely equipped with governor, hydraulic idling device, current indicator, polarity reversing switch, oil filter and is equipped for battery starting. It is notable for its lighter weight and compact size. No meters, rheostats, reactors or other gadgets which require frequent maintenance are used. This welding generator varies the current output by means of a magnetic shunt in the armature reaction flux path. The current output adjustment is mechanical. A handwheel on the side of the generator is turned for adjustment to any desired current setting which is easily and clearly read on a calibrated dial mounted behind a glass window inside the generator frame. The power unit, a model T50 Chrysler industrial engine, is claimed to be exceptionally reliable and economic. Its fuel consumption is only 2 gal. per hour when the set is operated continuously on a 200-ampere load. A down draft carburetor provides power with greatest economy under varying load conditions. Four main bearings insure permanent crankshaft alignment and eliminate vibration. Ample cooling capacity is provided by a sturdy radiator of standard construction.

▼

A New Oxy-Acetylene Cutting Attachment

A new oxy-acetylene cutting attachment has been developed by the Linde Air Products Co., Unit of Union Carbide and Carbon Corporation, for shops where the amount of cutting does not justify the purchase of a separate cutting blowpipe, and for those operations in the field where incidental cutting is to be done or where a minimum of equipment is desired. It is stated the new Oxweld (Type CW-23) cutting attachment will cut any thickness of steel up to 8 in. Due to a new, improved injector principle, it operates with exceptionally accurate control of gases, and performs



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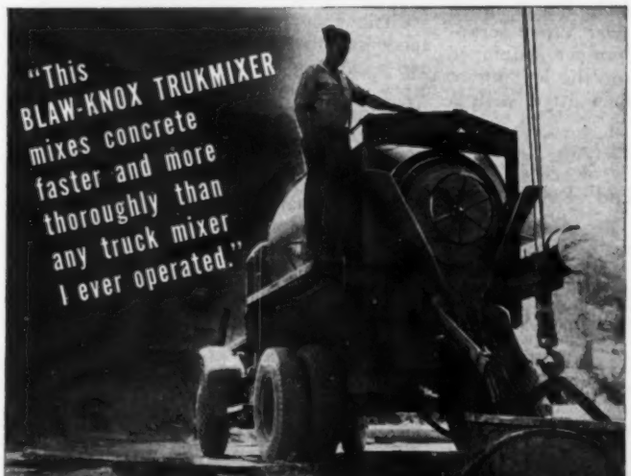

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MANY IMPROVED FEATURES
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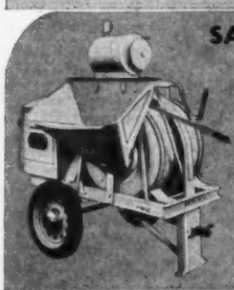

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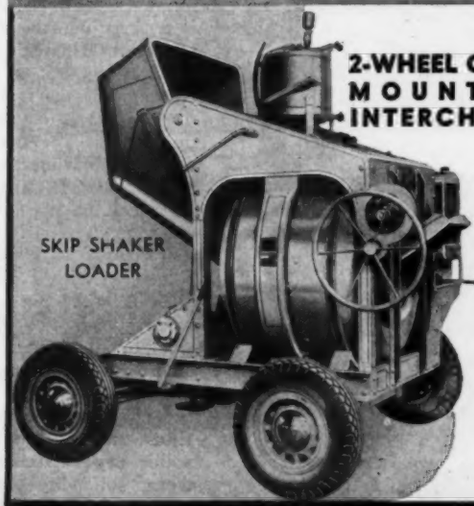
Pay about half the price of heavy 5S Non-Tilts, get up to 40 cu. yds. a day of quality concrete—
JAEGER "UTILITY" MIXER with MEASURING BATCH HOPPER
Fast as a costly Power Loader Machine—handy to move and trail.



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THE JAEGER MACHINE CO.
223 DUBLIN AVE. • • • COLUMBUS, OHIO

New Oxweld (Type CW-23) Cutting Attachment

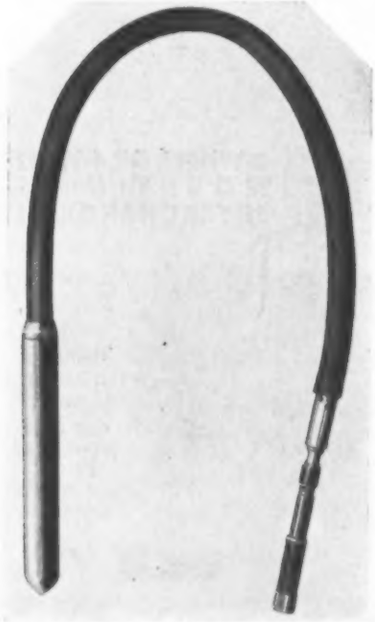
equally well with low-pressure or medium-pressure acetylene. It is also characterized by the unusual stability of its preheating flames and superior flashback resistance. The CW-23 can be used with either the W-17 or W-22 Oxweld welding blowpipes. It extends the usefulness of either blowpipe by adapting it to cutting steel, wrought iron, and cast iron.

▼

New Vibrator

A small diameter (2½ in.) light weight vibrator, designed for fast economical use in thin walls, floors and roof slabs, columns, pile castings, etc., where concrete is not under 3 in. slump, has been added to the line of the Chicago Pneumatic Tool Co., 6 East 44th St., New York. The specifications are:

V.p.m.	9,000
Capacity, cu. yd. per hour	15– 20
Weight, lbs.	30
Air consumption, c.f.m. under	30
Recommended operating pressure, lb.	90–100
Diameter vibrating tube, ins.	2½
Length vibrating tube, ins.	19



No. 219 C P Shimmy Spade

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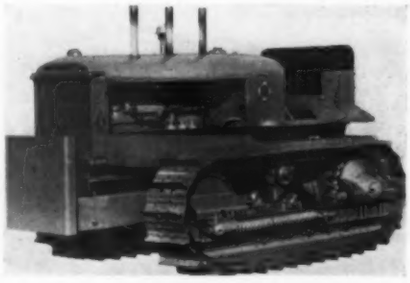
New Pusher Attachment for Tractors

To increase scraper yardage and reduce loading time, the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has designed a front-end bumper for its Model L-O tractors to be used for pushing tractor-scraper outfits while loading. The bumper is spring cushioned and mounted inside the truck frames in such a manner that the push is on the rear end of the tractor. The bumper has a face, 36 in. by 32 in., so contact with the scraper bumper can be made easily and quickly without shock. Though designed primarily for use with Gar Wood scrapers, Allis-Chalmers bumper equipped tractors can be used for the loading of any big capacity scraper fitted with a rear bumper.



Pusher Attachment for Tractors

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Vertical "Red End" Rules

These rules, which are a new item in the "Red End" Line of The Lufkin Rule Co., Saginaw, Mich., have inch numbers on both sides placed vertically, i. e., running perpendicularly from top to bottom (instead of the common way, horizontally left to right). With rule in either hand, vertical figures face the user directly when measuring upward or downward, yet are easy to read also when measuring right to left or left to right. The figures are never upside down to the user. Vertical "Red End" rules are offered in 6-foot length, in white enamel finish, and in two types, No. V-66 with outside marking; that is, with zero of both ends falling outside when rule is closed, No. V-66F with inside or flat marking, i.e., numbering commencing on inside face so measurement lies close to the work even with rule but partly open. Like all "Red End" rules these are rust-proof; have solid brass strike plates, preventing wear, solid brass lock joints, reducing end play and maintaining accuracy, sections of straight grain, tough and flexible hardwood, graduations, 16ths of inches, on both edges of both sides, superior, snow white enamel finish, and ends in gloss red, most striking and attractive. They are supplied either with or without folding end hook.

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New Special Marsh Buggy

The 1939 line of all-wheel-drive trucks manufactured by the Marmon-Herrington Co. of Indianapolis, Ind., includes a new and "special" model of the all-wheel-drive marsh buggy.

Fundamentally, the marsh buggy is a Marmon-Herrington all-wheel-drive Ford truck, especially engineered to accommodate the mounting of from four to ten 13.50 by 24 tires. The number of these tires furnished with the special marsh buggy varies in accordance with the type of terrain in which the vehicle is to operate. For less extreme conditions single tires front and rear are furnished, but for the deeper more difficult marshland ten tires are supplied, three on either side in the rear, and two left and two right in the front. Much engineering had to be done, of course, to provide proper axles and gear ratio for these extremely large wheels, and structural changes were necessary on the Ford truck chassis.

▼

WITH THE MANUFACTURERS

F. V. Gardner Elected Acting Treasurer of Chain Belt

Chain Belt Co., Milwaukee, Wis., has announced the election of Fred V. Gardner as Acting Treasurer to fill the vacancy created by the recent death of C. L. Pfeifer, and the election of John T. Brown, Vice-President, to the Board of Directors. G. M. Dyke, Assistant Treasurer, was re-elected and A. F. Kessler, Chief Accountant, was elected an Assistant Treasurer. Mr. Gardner, who has been connected with the company since early in the year in a consulting capacity, was formerly associated with General Electric Co., at Schenectady, as Supervisor of budgets, where he received the Coffin Foundation Award given yearly to the employe who performs the most outstanding service for the furtherance of the industry. He is a graduate of the University of Missouri and the Harvard Business School. Mr. Brown has been associated with the Chain Belt Co. since 1924, first as a student apprentice and then sucsively as production manager, works manager and since 1936 Vice-President. He is a graduate of Yale University. Mr. Dyke has been connected with the company since 1923, and shortly thereafter was made vice-president of the then new acquired Stearns Conveyor Co. at Cleveland. When the Cleveland operations were marged with the Milwaukee operations in 1933, Mr. Dyke returned to Milwaukee to become assistant treasurer. Mr. Kessler joined the organization in 1923 and has been chief accountant for the last ten years.

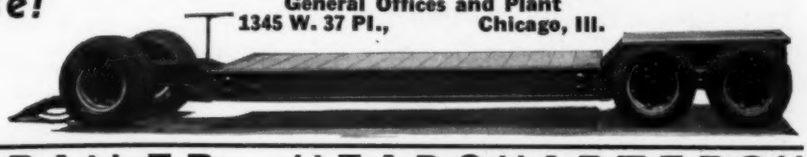
BIG TRAILER CAPACITY

With Single Purpose Trailer Loading-Ease!

HERE is trailer capacity up to 45,000 lbs. with the ease of loading that comes with light, single purpose trailers —just drop the front, load and jack the bed up and replace the wheels. This feature, combined with other Jahn Trailer advantages, means new speed. There are no ramps to build and the load can be definitely placed without fuss or maneuvering.

The loading platform is low and flush with outer channel. Tires are standard, available anywhere. Brakes, loading ramps, lash rings, stake pockets, safety chains, reflectors and flag sockets are standard equipment. Standard width is 8 ft., and either tandem or dual oscillating rear axels may be had. Other types and sizes up to 60 tons capacity. Don't buy a trailer without investigating Jahn Trailers.

C. R. JAHN COMPANY
General Offices and Plant
1345 W. 37 Pl., Chicago, Ill.



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Three books in one—Notes on Highway Location: Traffic Actualities and Possibilities; Speeds and Safety; Signs; Alignment; Grades; Widths; Recreational use of Highways affecting their Location; By-Passes; Economics and Formulae; Location Procedure. Notes on Mountain Highway Location; Controlling Factors; Kinds of Surveys; Structural Conditions; General Standards; Estimates, etc. General Instructions to Engineering Assistants. Notes on Highway Surveying.

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GILLETTE PUBLISHING CO.
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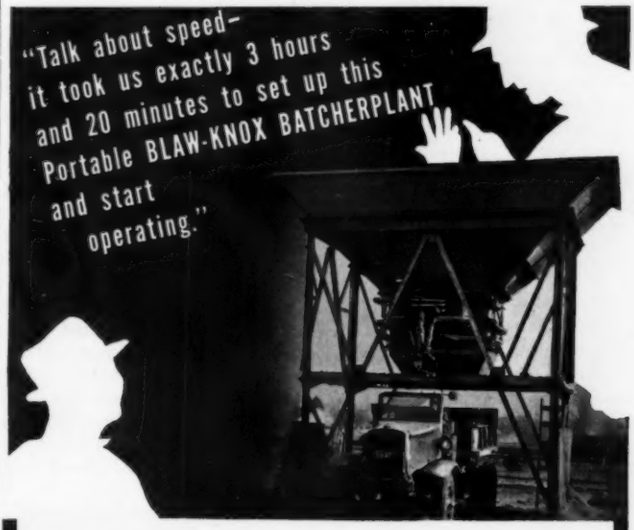

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Shipped complete with batching equipment attached—Blaw-Knox Batcherplants are made in a complete range of types and sizes, suitable for your work.

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LA CROSSE Heavy Duty TRAILERS

The most complete line on the market. Capacities, five to two hundred tons. Four to sixteen wheels. Two to eight axles. They are built to take the heaviest loads safely, and with the least damage to road beds. Write today. Just tell us what you have to move.

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Walker Elected Vice-President Oxweld

J. N. Walker has been elected vice-president of Oxweld Acetylene Co., a Unit of Union Carbide and Carbon Corporation, New York. Mr. Walker has been general sales manager of the Linde Air Products Co., also a Unit of Union Carbide and Carbon Corporation.

▼

C. E. Johnson, New IHC Assistant Advertising Manager

Carroll E. Johnson has been appointed assistant advertising manager, the International Harvester Company, effective Oct. 7, 1938. He succeeds A. C. Seyfarth, whose promotion to advertising manager was recently announced. Mr. Johnson joined the advertising department in May, 1903, after several years of retail selling experience. The International Harvester Co. had been formed a few months previously, and Mr. Johnson became affiliated with the McCormick division, named after one of the predecessor companies. His first job was in charge of direct-mail and house organ distribution. On this first job he had the difficult task of coordinating the distribution of predecessor company advertising, including four house organs, the Deering Farm Journal, the Farmers Advance (previously published by the McCormick Harvesting Machine Co.), the Illustrated Champion, and the Plano Harvester News. In 1909 Mr. Johnson joined the copy department and wrote general copy until July, 1915, when he was made copy chief. In these many years as copy chief, Mr. Johnson has played a big role in publicizing numerous important farm equipment developments, especially in power farming. He particularly deserves mention for his work on International motor trucks. In 1906 the first International motor truck, a high-wheeled vehicle called an auto wagon, was placed on the market, and the first and subsequent advertising copy on this outstanding motor truck development was prepared by Mr. Johnson. The year 1915, when Mr. Johnson became copy chief, is also a milestone in International motor truck history, for then the first low-wheeled International was brought out to supersede the high-wheeled auto wagon. From 1915 to the present day, paralleling Mr. Johnson's career as copy chief, the International line has grown and grown, until the current streamlined "D" line includes units ranging in capacity from the ½-ton light-delivery unit to the largest six-wheeler and consists of 30 models in 99 wheelbases. For the announcement of the International "D" line very effective copy in color was prepared under Mr. Johnson's direction. Color has been increasingly used in all other direct-mail publications. When Mr. Johnson became copy chief, around 1,000,000 pieces of direct-mail copy were mailed out each year. Now an average of 5,000,000 pieces is mailed from Chicago annually.

C. E. Johnson

▼

Miles and Hague Promoted by S. O. of Indiana

E. W. Miles, assistant manager of the asphalt and fuel oil department of Standard Oil Co. of Indiana, has been promoted to manager to succeed C. C. Lakin, who has retired on company annuity after almost 24 years' service. A. T. Hague, sales engineer in the asphalt and fuel oil department, has been promoted to assistant manager to succeed Mr. Miles. Mr. Miles joined Standard Oil in 1934 as manager of the domestic heating oil department, after aiding to develop and serving as president of the Murphy-Miles Oil Co. of Chicago. He became assistant manager of the consolidated asphalt and fuel oil department in 1937. Mr. Lakin became associated with Standard Oil in 1915 as an asphalt sales expert, after 26 years' experience in construction engineering and asphalt manufacturing. In 1918 he was appointed the company's representative in the mid-continent field with headquarters at Tulsa, Okla. He was transferred to the sales department as manager of the Joliet, Ill., division in 1922, returned to the Chicago general offices as assistant manager of the asphalt department in 1923, was promoted to manager of the asphalt department in 1924 and became manager of the consolidated asphalt and fuel oil department in 1937. Mr. Lakin is a former director of the Asphalt association. Mr. Hague joined Standard Oil in 1926 as a sales engineer on paving asphalt, after five years' experience in paving construction work.

C. C. Lakin

E. W. Miles

A. T. Hague

▼

N.I.A.A. Adds Its Second Canadian Chapter

The Technical Advertisers Association of Montreal has received its charter from the National Industrial Advertisers Association and became the 17th N.I.A.A. chapter. The charter was presented by Herbert V. Mercready, Advertising Manager of the Magnus Chemical Company, Garwood, N. J., the first president of the Industrial Marketers of New Jersey and recently elected a vice president of N.I.A.A. Mr. G. A. Brace, Sales Manager, Ferranti Electric Ltd., Toronto, presided, and, after a few opening remarks, introduced Vincent Young of Canadian General Electric, past president of Industrial Advertisers Association of Toronto and also a newly-elected vice president of N.I.A.A. Mr. Young introduced Mr. Mercready. Following the latter's charter presentation speech, the acceptance speech was made by Mr. H. S. Van Scoyoc, president of the Technical Advertisers Association of Montreal. After the conclusion of Mr. Van Scoyoc's remarks, the representatives of several associations offered the congratulations of their groups and promised N.I.A.A.'s newest chapter every cooperation. These associations included the following: Association of Canadian Advertising Agencies, Canadian Business Publishers' Association, Association of Canadian Advertisers, Canadian Circulation Audit Bureau, Advertising Club of Montreal.

▼

Cartledge Appointed General Sales Manager of Linde

T. D. Cartledge, formerly assistant general sales manager, has been appointed general sales manager of the Linde Air Products Co., a Unit of Union Carbide and Carbon Corporation, 30 East 42nd St., New York.

▼

A. L. McLain Dies

A. L. McLain, Assistant to the Sales Manager, of The Thew Shovel Co., Lorain, O., died suddenly Sunday, Oct. 23, in Cleveland, O. Mr. McLain was a native of Greenville, Tex., and was a member of The Thew Sales Department for the past 10 years. Eight of these were spent as Southwestern District Sales Manager at Dallas, and the last two years as assistant to the Sales Manager at Lorain, O. Mr. McLain's sudden death will be a shock to his many friends in the Southwest and Pacific Coast, where he has spent much of the last two years. Mr. McLain is survived by his wife, his mother, Mrs. C. E. McLain, Greenville, and two brothers, C. E. McLain of Dallas and J. M. McLain of New York City, both members of The Thew Sales Department.

▼

List of 1939 Industrial and Trade Shows

The 4th annual edition of its show schedule, which includes 1939 national, regional and state, industrial, trade, commercial, professional, etc., shows and exhibitions, has been announced by the Exhibitors Advisory Council, 122 East 42nd St., New York City. The 1939 schedule is by far the largest listing of shows ever compiled and represents a substantial increase over the 1938 and 1937 editions. Each listing includes the name of the show, the date and loca-

tion and for the first time, the address of the show sponsor is also included. Easy reading of the schedule is made possible by an index which classifies the shows according to industries, trades, professions, etc. The price of the book is $4. The following is a partial list of the classifications:

Agriculture, Farm Products, etc.
Aircraft.
Arts, Architecture, Science.
Automotive, Automobiles.
Business and Commercial.
Construction, Building Materials, Roads, etc.
Electrical, Radio and Refrigeration.
Gas, Petroleum, Coal, etc.
Hardware.
Industrial—Machinery, Metals, Power and related equipment.
Lumber, Timber Products.
Railway, Transportation.
Water Works, Utilities.
Miscellaneous.

▼

Increase in International Motor Truck and Tractor Production

A program of increased tractor and motor truck production, which, over a period of several weeks, will return several thousand men to jobs at tractor and motor truck plants in Chicago, Milwaukee, Fort Wayne, Ind.; Springfield, O.; and Rock Island, Ill., has been announced by the International Harvester Co. The company's increased manufacturing activity began early in October at these plants. Estimates are that about 6,500 men will return to work at the company's automotive plants over the next several weeks. Workers will be returned to their jobs according to seniority of service agreements with employes, in effect at each of the three plants. Employment will also be stimulated in the company's West Pullman plant in Chicago, which makes auxiliary parts, as a result of the re-employment in the automotive plants. The Harvester Company's increased truck and tractor program has been made possible as a result of improvement in tractor and motor truck sales in recent weeks, which have reduced the large inventories which caused the company to cut down operations at its plants very materially in July and August. Sales estimates have now been made for the autumn, winter, and spring months, Fowler McCormick, second vice president of the Harvester Company, in charge of manufacturing, said. Estimates have been made of both domestic and foreign sales in order to develop as large a manufacturing program as possible for the winter months. Company officials expressed the belief that their future sales estimates are sufficiently conservative to warrant continuance of the enlarged manufacturing schedule well into the spring of 1939.

▼

NEW LITERATURE

Steel Sheet Piling—A 24-page catalog on Bethlehem steel sheet piling has been issued by the Bethlehem Steel Co., Bethlehem, Pa. Types, dimensions and properties of sections are given as well as diagrams of cofferdams, both rectangular and circular types. Tables also are included for maximum spans under water loads, and for allowable safe loads per linear foot of wall.

Preventing Slipperiness of Icy Pavements—A booklet on the use of rock salt in making icy pavements safe has been issued by the International Salt Co., Scranton, Pa., and New York, N. Y. It contains detailed directions for using rock salt either to prevent ice formation or to make pavements safe after ice had formed. Correct and proved methods are given for using rock salt alone or combined with other abrasives.

Concrete Mixer—A bulletin (*No.* 153) just issued by the Ransome Concrete Machinery Co., Dunellen, N. J., fully describes the new 3½-S Tilting Mixer recently designed and built by them. It contains condensed specifications, dimensions, graphically illustrated operating features, and each function is clearly described.

Diesels—A new 40-page bulletin on Type "S" Diesel Engines has just been published by Ingersoll-Rand Co., 11 Broadway, New York City. This machine is a heavy-duty, continuous-service, compact engine for stationary or marine-electric application.

Motor Graders—Just released by the Allis Chalmers Mfg. Co., West Allis, Wis., is a beautifully illustrated 32-page pamphlet in colors discussing various features of their Allis-Chalmers speed patrols. It is entitled "Change By-Ways to Highways." Several uses of these motor graders are shown with a little discussion about each. Included are charts of horsepower and torque. Page 31 is devoted to detailed specifications of three models.

New Handbook on Tires—Including for the first time a table on the effect of load and speed on tire service, with percentages of recommended maximum loads at maximum sustained speeds to obtain normal tire service, The B. F. Goodrich Co., Akron, O., has just published an operators handbook on truck, bus and farm and industrial tractor tires. Copies can be obtained upon request to the company. Containing 66 pages, the volume is crammed with statistical material of interest to every operator of commercial vehicles, on highways, farm and factory. Description and specifications of the company's products for these varied services are included. Four pages are given to a discussion of how to prevent truck tire failures, including the heat-speed problem. Two pages are devoted to methods of correctly calculating truck tire costs, with a description of the company's new and improved truck tire calculator. This calculator can also be obtained upon request. Truck and bus tire descriptions and specification data fill 20 pages. Eight pages are devoted to data and descriptions of farm tractor and implement tires. Twelve pages on data of tires for industrial uses are included. Load analysis, load and service diagrams, load ratios and inflation pressures, and specifications for truck and bus tires, rims and dual spacings comprise six pages.

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¾ YD.
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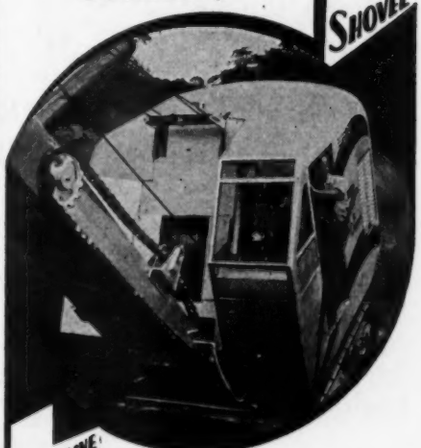
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CLAMSHELL
CRANE
PILE DRIVER
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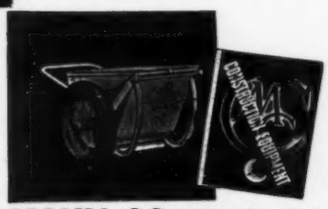

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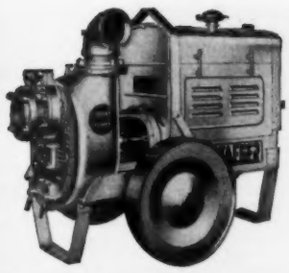

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International Road Exposition at Santiago, Chili, Will Start in December

Announcement of this exposition is made elsewhere in the September issue of ROADS AND STREETS. It is considered of especial importance because it is expected that the Third Pan-American Road Congress, to be held in Santiago in January, 1939, will attract an unusual number of engineers and road builders. Officers in charge are: President of the Exhibition, Engineer C. Ponce de León, Director of the Road Department; Commissioner General, Engineer Roberto Torretti; Secretary, Engineer C. Valenzuela Cruchaga; all of Santiago. It is understood that local Chilean representatives in the United States are also able to furnish information.

REGULATIONS GOVERNING THE INTERNATIONAL HIGHWAY EXHIBITION

Article 1.—The Organizing Committee of the Third Pan-American Highway Congress, which is to take place in Santiago, Chile, in January, 1939, has decided in agreement with the Supreme Government, to hold an International Highway Exhibition to permit Chilean and foreign engineers attending the Congress, to study recent progress in machinery and materials employed in the construction and upkeep of roads and in the motorized and non-motorized vehicles which travel over them.

Article 2.—This Exhibition, which will be situated in a properly enclosed and conditioned site at the entrance to Cousiño Park, surrounded by gardens, will be inaugurated in December of this year and will remain open for a period of from forty-five to sixty days.

Article 3.—The organization and administration of the Exhibition will be in charge of a Commissioner General and his secretary. There will be, furthermore, an Award Committee to allocate prizes, composed of five persons appointed by the Organizing Committee of the Third Pan-American Highway Congress.

Article 4.—The Commissioner will have full powers to determine all matters relating to the Exhibition. The plans and bids for the latter, however, must be approved by the aforementioned Organizing Committee of the Congress.

Article 5.—In general, the International Highway Exhibition will include the following Sections:

Section 1.—Materials for highways.

Section 2.—Machinery for the construction and upkeep of highways, including equipment and tools.

Section 3.—Motorized vehicles and their spare parts.

Section 4.—Animal-drawn vehicles and their spare parts.

Section 5.—Types of urban, suburban and rural roads.

Section 6.—Exhibits of the official Highway Bureaus of the countries attending the Pan-American Highway Congress.

Article 6.—Exhibitors shall pay for stands with the Exposition grounds, the rates being twenty pesos Chilean currency per square meter for stands in the open air, and fifty pesos the square meter for covered stands. The total amount must be paid half down upon filing application for space and the remaining half upon delivering the material to be exhibited.

Article 7.—An Official Catalogue will be published of the Exhibition in which all Exhibitors will have preferential right to be mentioned in the respective lists.

Commercial advertising rates will be moderate and will be fixed at a later date.

Article 8.—The material to be exhibited must be delivered at the grounds of the Exhibition before the first of December of the present year.

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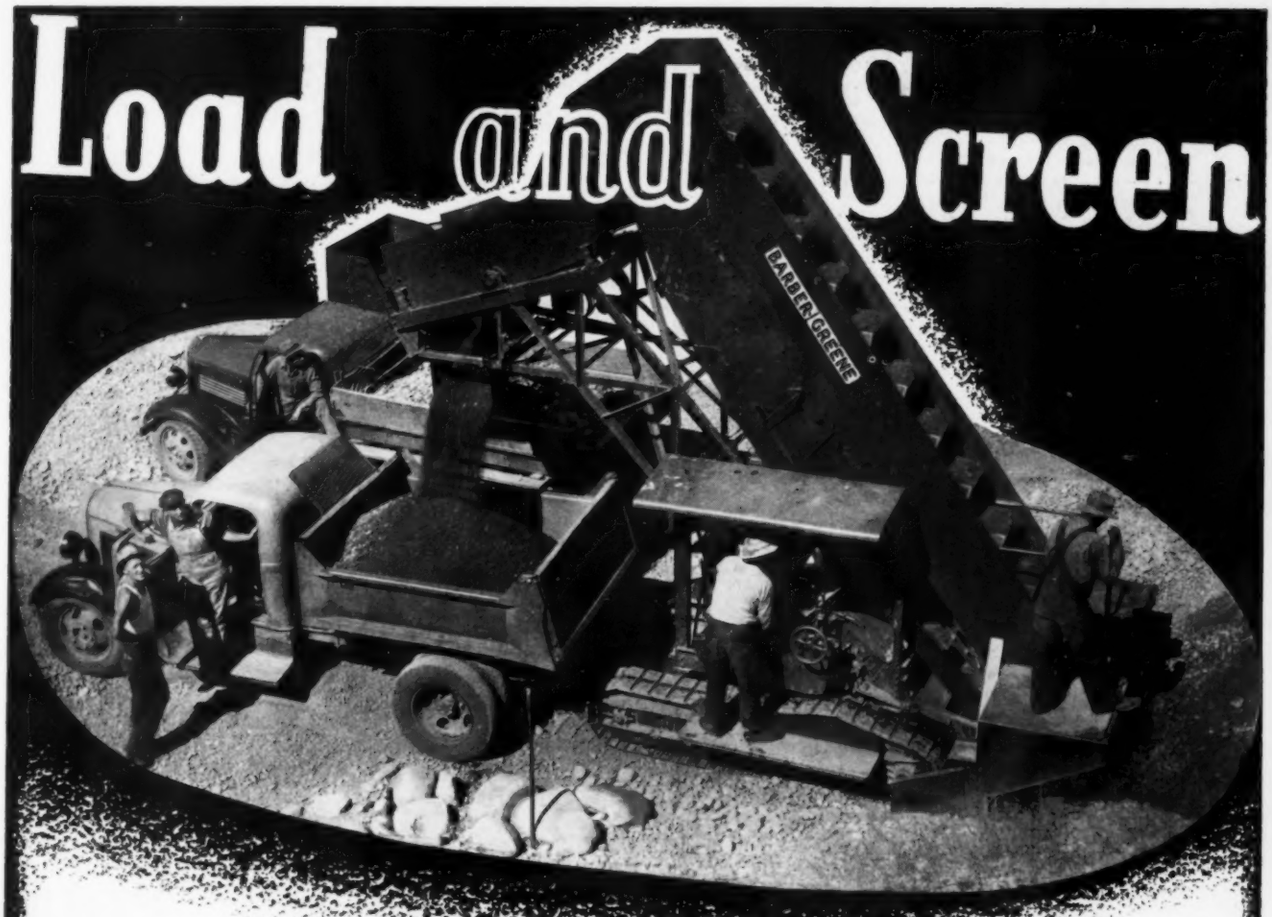

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A DARN GOOD MACHINE

"THE FLEX-PLANE GAS ELECTRIC FINISHING MACHINE"

The "FLEX-PLANE" gas electric 20″ wide single screed finishing machine has and will finish "no slump" concrete. It walks away with 1″ slump and leaves a beautiful, level riding surface. The "FLEX-PLANE" gas electric finishing machine is built low-down—with or without vibrators.

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What a spot to install a new drainage outlet! Under four main line railroad tracks . . . 156 passenger trains daily . . . speeds up to 80 miles an hour! Yet this 48-inch Asbestos Bonded Armco Pipe was jacked through the fill — a total distance of 62 feet *without a moment's delay to traffic.*

Developed years ago by Armco engineers, this method of jacking pipe through embankments has simplified many a tough drainage problem. Culverts, sewers and utility conduits can now be quickly installed without interrupting traffic or disturbing expensive road surfaces. Besides, there is no danger to workmen because the entire jacking operation is completed *below road level.* This also helps reduce costs and prevents settlement of the roadbed.

If you are considering new openings or replacements under existing roads, Armco engineers can offer you helpful assistance based on years of experience with hundreds of similar jobs. Just outline your problem in a postal card or letter. Or better still, discuss it with your local Armco representative. Armco Culvert Manufacturers Association, Middletown, Ohio.

ARMCO

Asbestos Bonded

ARMCO PAVED PIPE

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

1939 DODGE TRUCKS LEAD IN THE 5 VITAL FEATURES THAT MEAN REAL ECONOMY FOR CONTRACTORS

New 1939 Dodge 1½-Ton, 126¼" W. B., Special Dump Body.

SEE WHY AMERICA'S HANDSOMEST TRUCK IS SUCH A RUGGED MONEY-MAKER!

NEW Dodge trucks for 1939 give you distinguished new styling, new larger cabs, new rust-proofing, new features from one end to the other that will save you money on upkeep, make your truck last longer. Yet Dodge trucks are priced with the lowest! In "truck-built" Dodge trucks for 1939, Dodge gives you 5 vital advantages. Compare! Then see your Dodge dealer.

1 BONDERIZING—(Special Rust-proofing)—A revolutionary step ahead! Dodge bigger cabs for 1939, bodies, all sheet metal rust-proofed in huge new processing machines at the giant new Dodge truck plant.

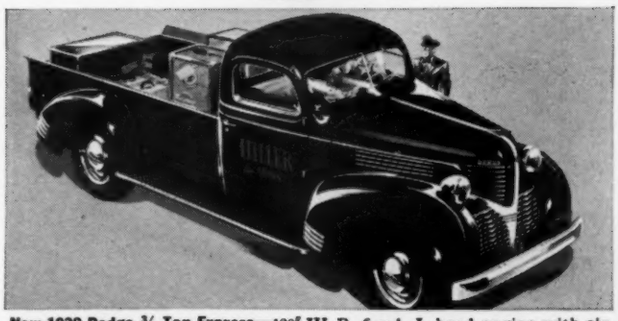
2 AMOLA STEEL—This new super-tough steel is used for 1939 in vital Dodge truck parts.

3 STYLING—Distinguished, streamlined appearance for 1939 makes Dodge a moving advertisement to build prestige for your business.

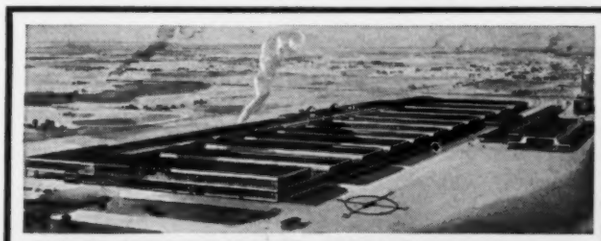
4 ENGINE—Dodge 6-cylinder L-head engine is simplest in design, has fewer parts, yet gives you many extra gas and oil saving features.

5 BRAKES—Dodge has genuine hydraulic type, fully equalized, stop quick yet save tires and brake linings.

NEW LOWER PRICES...EASY BUDGET TERMS



New 1939 Dodge ¾-Ton Express—120" W. B., 6-cyl., L-head engine with six special gas and oil saving features. Many extra quality advancements. Body size 48¾" x 90", especially useful for handling bulky materials.



WHAT "TRUCK-BUILT" MEANS TO BUYERS!

Dodge has just completed a giant new truck plant, at a cost of millions, to carry on the tradition of Dodge "truck-built" quality. New manufacturing methods, huge new processing equipment, miles of ultra-modern conveyors, now make possible the greatest Dodge truck values of all time. See your Dodge dealer.

YOU CAN HANDLE ALL YOUR REGULAR GRADER WORK

plus high, hard bank cuts

WITH THE *LEANING FRAME* GRADER

Now you can get up on the banks of deep cuts (see picture at right) and do a real grading job ... by using the Allis-Chalmers Leaning Frame Grader. The leaning frame enables you to shift the grader's center of gravity to fit the slope, even though it be as steep as 1:1. You lean both the frame and the wheels into the work, thus hold the grader to its job ... without slipping ... on slopes where other graders cannot even stick. When cutting back slopes (see picture below) this same leaning frame feature enables you to take deeper, heavier bites ... because you're able to lean the frame weight on the moldboard and so gain extra pressure for cutting through tough materials or shearing off roots. Once the blade is set to the specified cross-section, you obtain uniform slopes simply by keeping a level platform with frame lean control. Thus, whether working on the bank or against it, the Leaning Frame Grader enables you to do a smoother job in fewer rounds and practically eliminates slow, costly hand labor.

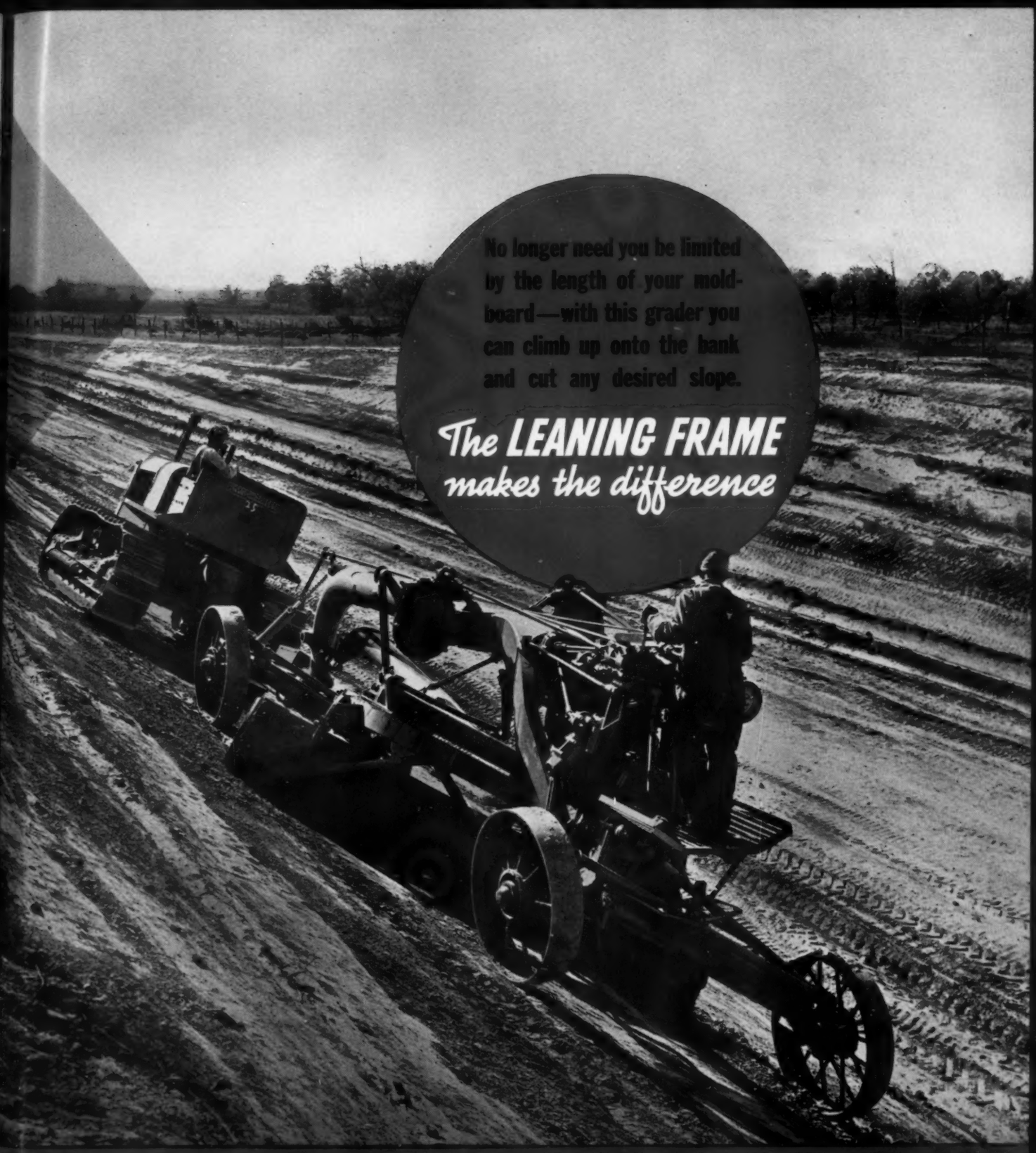
See for yourself—on your own job—***what a difference the Leaning Frame makes.*** Ask your Allis-Chalmers dealer to demonstrate.

TWO SIZES

No. 110 with 10 and 12-foot blades — No. 112 with 12 and 14-foot blades — with either steel wheels or pneumatic tires.

WORKING ON STEEP SLOPES—Model L tractor and No. 112 Leaning Frame Grader, owned by Eiff Construction Co., finishing 2:1 slope on Illinois State Highway 108. Note the upright position of the frame ... weight is leaned up the bank so there is no tendency to tip or slide to the bottom. Level operating platform enables operator to handle controls in comfort.

CUTTING BACK SLOPES—Model L and No. 112 Leaning Frame Grader, owned by Salisbury Township, Missouri, cutting back slopes for a new road. A-C's Natural Action controls enable the operator to use both frame lean and lift arms simultaneously and thus speed adjustments.


No longer need you be limited by the length of your mold-board—with this grader you can climb up onto the bank and cut any desired slope.
The LEANING FRAME makes the difference

ALLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

Gasoline and Controlled Ignition All Track-type Tractors from 32 to 80 Drawbar H. P. . . Tandem and Single Drive Speed Patrols . . Drawn Motor Graders . . Speed Maintainers . . Industrial Wheel Tractors . . Stationary Power Units from 15 to 102 Brake H. P. . . . Two, Four and Six-Wheel Scrapers, Bulldozers, Trailbuilders, Loaders, Winches and other Allied Equipment.

Well-stocked warehouses throughout the country are a major factor in Bethlehem's service to road builders

A set up for action

in getting ROAD STEEL to you

You get streamlined service when you order road steel from Bethlehem. First of all, the complete range of road steel products manufactured by this company enables you to concentrate your orders with a single source of supply, which often means a better freight rate and simplifies ordering. Second, your order, no matter what its size may be, is treated as a unit, with delivery dates arranged to keep pace with your working schedules. Last but not least, Bethlehem has warehouses at strategic points throughout the country. Warehouse stocks are kept up to par at all times, an important feature when you have to take an unforeseen emergency in your stride.

Before you start work on your next contract, make it a point to get in touch with the Bethlehem office nearest you. Having detailed information on Bethlehem's road steel service may be your key to a faster, more profitable pace in road building.

OTHER BETHLEHEM PRODUCTS FOR HIGHWAY BUILDING: Bar Mats—Welded Wire Fabric—Contraction Joints (Road Strip)—Reinforcing Bars—Dowels—Bar Ties—Highway Guards—Bethlehem Steel Sheet Piling—Bethlehem Steel H-Piling—Miscellaneous Products.

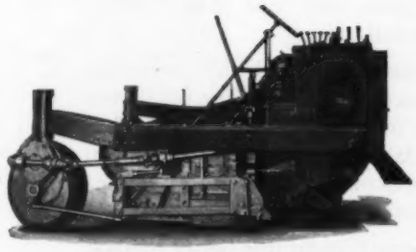
BETHLEHEM STEEL COMPANY, *General Offices:* Bethlehem, Pa. *District Offices:* Albany, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Detroit, Honolulu, Houston, Indianapolis, Johnstown, Pa., Kansas City, Mo., Los Angeles, Milwaukee, Nashville, New Haven, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, Salt Lake City, San Antonio, San Francisco, Savannah, Seattle, Syracuse, Toledo, Tulsa, Washington, Wilkes-Barre, York.
Export Distributor: Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Again ADNUNS

for ALABAMA



Adnun Black Top Paver showing hydraulic controls

ANOTHER State specifies Adnun. The Alabama State Highway Department has just taken delivery on four more Adnun Black Top Pavers, making a total of six of these machines for this State.

Alabama is only one of the many states using Adnuns. Among them are the State of New York with nine Adnuns, and the State of Pennsylvania with eighteen Adnuns. If you have a Black Top road job, you'll make more money with an Adnun.

THE FOOTE COMPANY, INC.
NUNDA NEW YORK

ADNUN
TRADE MARK REGISTERED

BLACK TOP PAVER
with Hydraulic Controls

IT'S SPEED YOU NEED FOR ICE CONTROL

CALCIUM CHLORIDE

GIVES *fastest results*

Above — Ice strikes without warning, demands emergency action! With calcium chloride method of ice control, you are always ready for instant action.

●

Extreme left — Dangerous driving! Every minute counts when ice sheathes roads with treacherous surfaces.

●

Left — Calcium chloride treated grits, always ready, spread smoothly, swiftly, form safe tractive surface speedily.

●

THE first hour after highway ice is treated—that's the test of ice control methods! Is it immediately effective, or do the grits take their own sweet time to embed themselves into the surface of the ice?

With calcium chloride treated grits, embedment starts at once. The melting action of calcium chloride is *fast*, faster than any other chemical used for similar ice control treatment. At any temperature from freezing down to 50° below, calcium chloride melts its own weight of ice in less time.

The quickly formed safe surface isn't the only advantage of the calcium chloride method of ice control! Stock piles are maintained unfrozen, loose, and ready for loading into spreader trucks without loss of time. Free-flowing abrasive material spreads more evenly, more economically, higher speeds are possible for the spreader truck. With the greater efficiency of calcium chloride treated grits, one load goes farther, skidproofs more road!

The economy of the calcium chloride treatment makes itself apparent in the smaller quantities of abrasives used, in time saved by all-weather effectiveness, in labor saved because calcium chloride keeps stockpiles unfrozen no matter what the temperature.

Get complete information on this better method of ice control. A letter will bring you full data by return mail.

CALCIUM CHLORIDE ASSOCIATION

4145 PENOBSCOT BUILDING • DETROIT, MICHIGAN

The Dow Chemical Company
Midland, Michigan

Michigan Alkali Company
60 E. 42nd St., New York City

Solvay Sales Corporation
40 Rector St., New York City

The Columbia Alkali Corp.
Barberton, Ohio

CALCIUM CHLORIDE
FOR BETTER ICE CONTROL

You Don't Need an Elephant

To Get a BARCO on Location

• Yet a BARCO will work as long and as tirelessly with as little upkeep.

Put one on the job—watch it perform like a top day after day—when the work is completed, check up on the savings battered out for you.

A real money saver with a nominal investment.

How about letting us demonstrate to you on YOUR job? The selection is yours, whether digging, driving, breaking, drilling or tamping.

BARCO MANUFACTURING COMPANY
1819 W. Winnemac Ave., Chicago, Ill.

BARCO *Portable* GASOLINE HAMMER

If You compare POINT for POINT

There is not a single part of an Owen Bucket that has not been improved or refined as a result of many years of specialized experience.

These features combine to produce a bucket that is unapproached in handling capacity and durability.

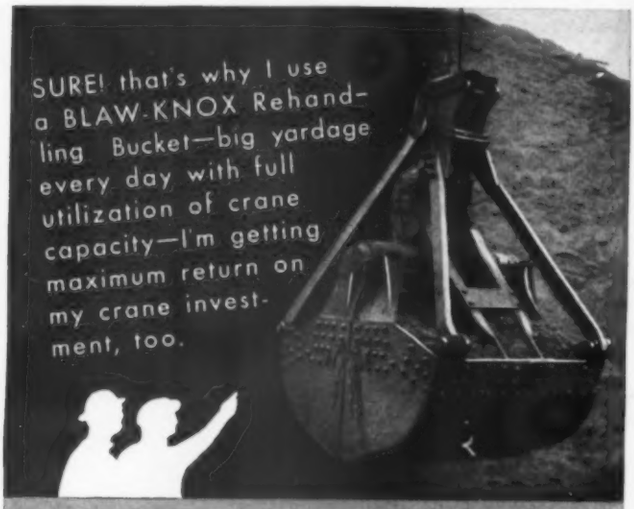
Check these points in the Owen Catalog and we believe you'll buy an Owen Bucket.

The OWEN BUCKET Co.

6070 Breakwater Avenue - Cleveland, Ohio

Branches: New York Philadelphia Chicago Berkeley, Cal.

You'll Buy an Owen Bucket and get A MOUTHFUL AT EVERY BITE


SURE! that's why I use a BLAW-KNOX Rehandling Bucket—big yardage every day with full utilization of crane capacity—I'm getting maximum return on my crane investment, too.

Bulletin 1606 entitled Blaw-Knox Buckets for Contractors shows how to select a bucket to secure the profitable difference between peak and ordinary performance—it will be sent on request.

BLAW-KNOX DIVISION of Blaw-Knox Company
FARMER'S BANK BUILDING PITTSBURGH, PA.

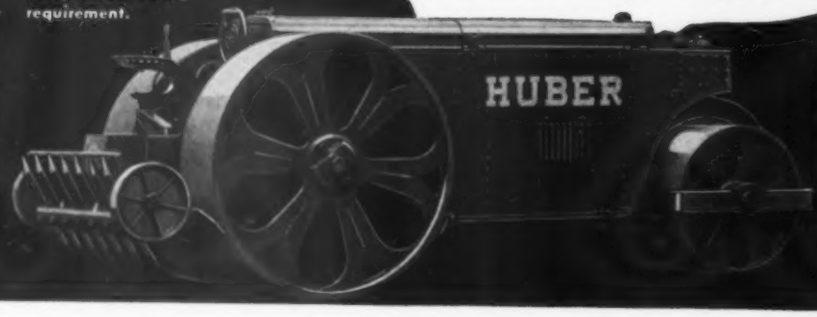
BLAW-KNOX
REHANDLING BUCKETS

Did You Know That—

THE EARLY "TURNPIKE," IT APPEARS, WAS A HORIZONTAL BAR OF WOOD FITTED WITH PIKES AND SWINGING ON A VERTICAL PIVOT, WHICH WAS USED IN NORTH HOLLAND DURING THE 17TH CENTURY "LOW COUNTRY" WARS TO BLOCK HOSTILE CAVALRY RAIDS. THIS GENERAL TYPE OF BARRIER, MINUS THE PIKES, LATER WAS ADAPTED TO USE ON TOLL ROADS AS A MEANS OF CLOSING OFF HIGHWAYS TO TRAFFIC UNTIL TOLLS HAD BEEN PAID.

All jobs are a "CINCH" with the new **HUBER**

6 Sizes—from 5 to 12 ton. A Huber for every road building requirement.



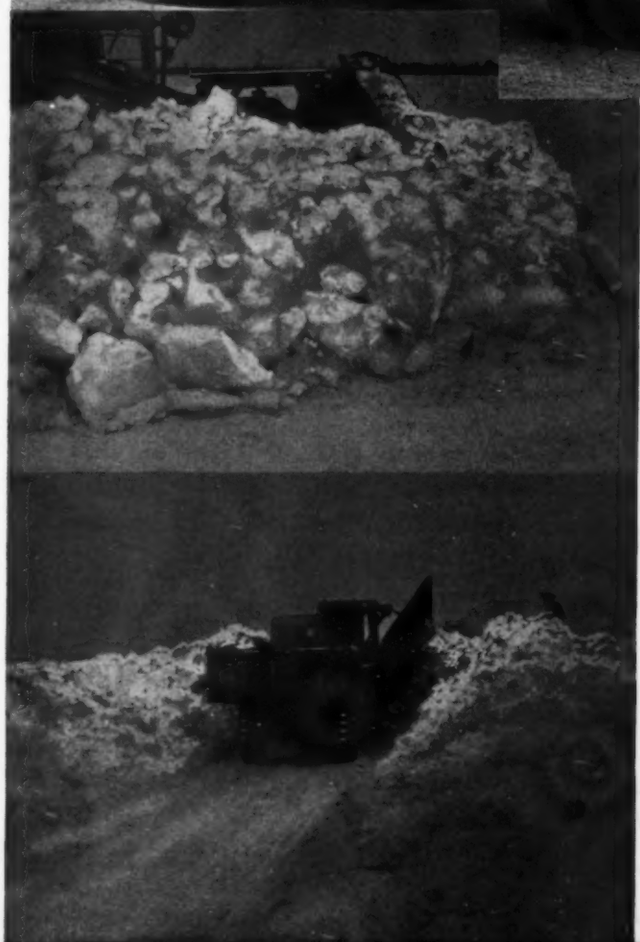
To fully appreciate this is to put a New Huber Road Roller on that next road job.. Make us prove this statement. Buy by comparison and you will buy a Huber.

Write for Bulletins

THE HUBER MFG. CO.
MARION, OHIO

When you need *better* than "four-wheel drive"

Walter AXRS Snow Fighter, 200 H.P., 7 to 10 Ton, with Sedan Cab, V Plow, Right Wing, Power Hydraulic Control.



"What IS better than 4-wheel drive," you ask? Only one thing — WALTER FOUR-POINT POSITIVE DRIVE.

For Walter Snow Fighters and Tractor Trucks are the only vehicles equipped with a differential action that automatically proportions the power among the wheels according to their requirements at any instant. The Walter Patented Automatic Lock Differentials divide the power so that the wheels with least traction get the least and those with the most traction the most power. If one wheel should lose traction momentarily, its mate does not go on a "sympathy strike", but continues to operate under full power.

Walter Snow Fighters, with their superior differential action, unique suspended double reduction drive, exceptionally powerful motors and scientifically correct weight distribution, offer you the greatest possible assurance of open roads and unhindered traffic after heavy blizzards. That is why those communities and fleet owners, exposed to severe winter conditions, find the solution to their problem in WALTER FOUR-POINT POSITIVE DRIVE.

Send for Literature

WALTER MOTOR TRUCK CO.

1001-19 IRVING AVENUE, RIDGEWOOD, QUEENS, L. I., N. Y.

WAS HE *Surprised!*

WHEN HE LOOKED THROUGH THE NEW 1939 POWERS' ROAD AND STREET CATALOG

● The new 1939 *POWERS' CATALOG* holds a surprise for everybody the first time they look through it. The reaction is all the same: "Just the book we have been looking for! Now it's all in one place! Yes, we can discard all those separate information sheets—we found it all in the new *POWERS' CATALOG.*"

And it's easy to find with fourteen separate sections classified for your convenience—you want to put Rubber Tires on that old grader—turn to Section 10—Wheels, Tires and Equipment Accessories and find all the information you need.

There's also Engineering Data—Directory of Manufacturers—Manufacturer's name Index—Directory of Dealers and Distributors—and Directory of Highway Officials—Federal, State and County—all in this new *POWERS' CATALOG.*

(Out March 15, 1939)

NAN S. POWERS, PUBLISHING DIRECTOR

Published by

GILLETTE PUBLISHING COMPANY

330 S. WELLS ST. CHICAGO, ILL.

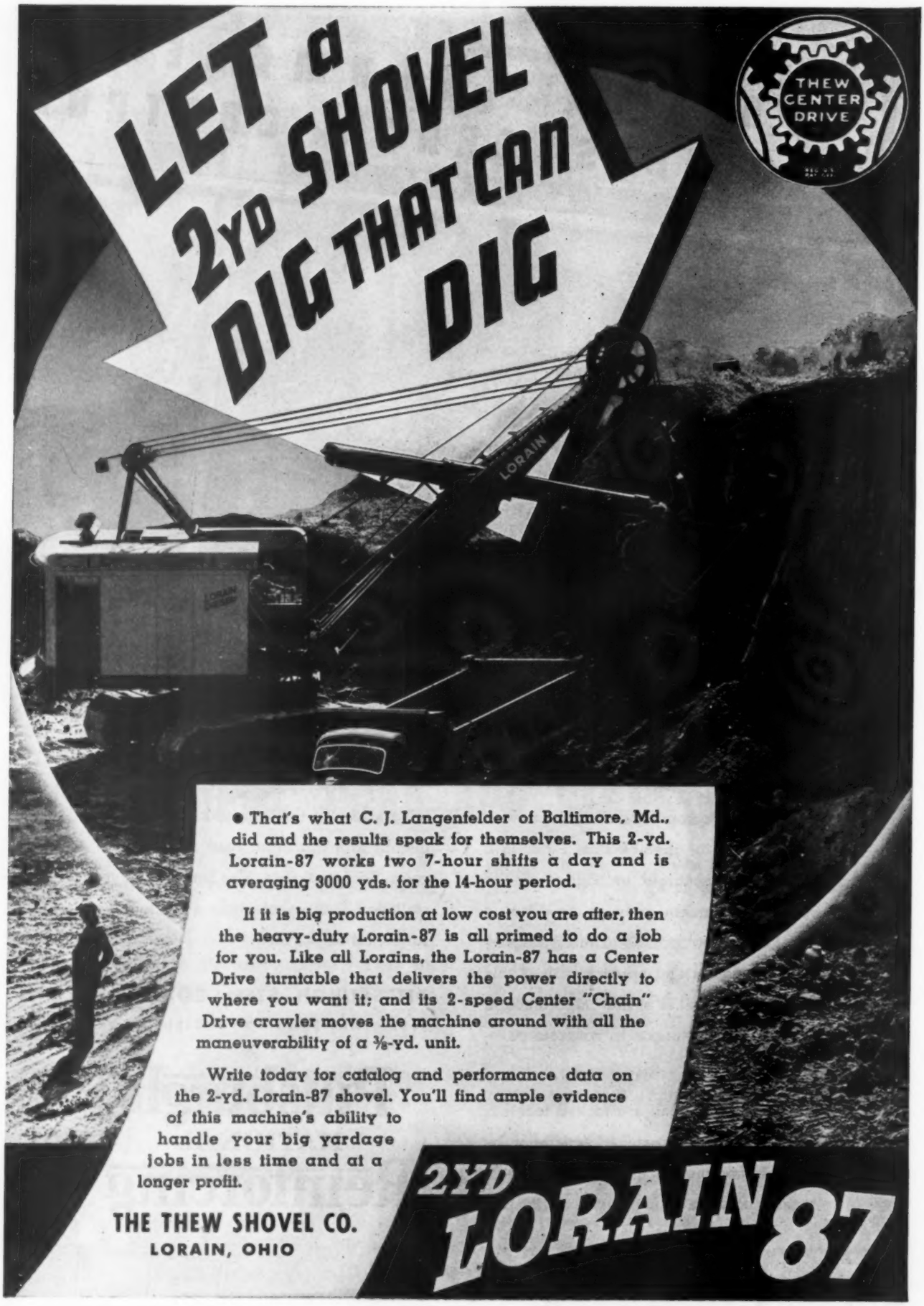
The correctly computed strength and accurate spacing of members in *Pittsburgh Reinforcing*, securely embedded in the concrete pavement, prevent the opening up of incipient cracks and their progressive elongation and spreading. It is this crack-control that is of first importance in achieving permanence in concrete pavements.

All parts of the slab are locked together over any line of threatened separation by this reinforcement of closely spaced high-tensile cold-drawn steel wires effecting full transfer of the imposed load and reducing to a minimum road maintenance costs. Technical data, also service and installation equipment information will be furnished on request.

PITTSBURGH STEEL COMPANY
1661 GRANT BUILDING · PITTSBURGH, PA.

Pittsburgh NATIONAL Reinforcing

Prompt deliveries assured.
Types for all state specifications.



● That's what C. J. Langenfelder of Baltimore, Md., did and the results speak for themselves. This 2-yd. Lorain-87 works two 7-hour shifts a day and is averaging 3000 yds. for the 14-hour period.

If it is big production at low cost you are after, then the heavy-duty Lorain-87 is all primed to do a job for you. Like all Lorains, the Lorain-87 has a Center Drive turntable that delivers the power directly to where you want it; and its 2-speed Center "Chain" Drive crawler moves the machine around with all the maneuverability of a ⅜-yd. unit.

Write today for catalog and performance data on the 2-yd. Lorain-87 shovel. You'll find ample evidence of this machine's ability to handle your big yardage jobs in less time and at a longer profit.

THE THEW SHOVEL CO.
LORAIN, OHIO

2YD LORAIN 87